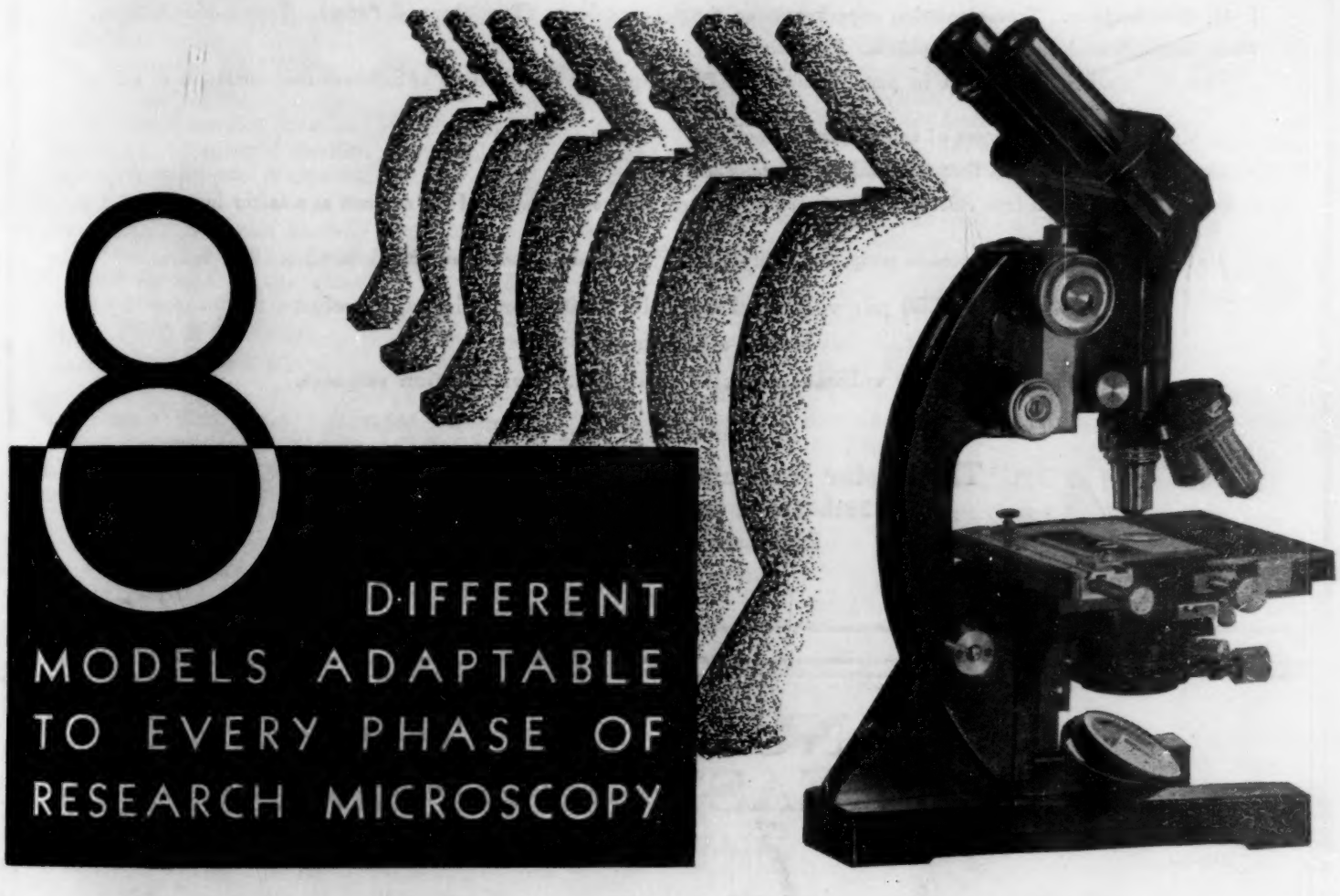
JAN 1 8 1936
PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

SCIENCE

NEW SERIES
VOL. 83, No. 2142

FRIDAY, JANUARY 17, 1936

SUBSCRIPTION, $6.00
SINGLE COPIES, .15



EIGHT different models of the G type B & L Microscope provide a selection of models for every phase of research microscopy. In this group you will find the one model best suited for your particular research work.

Monocular and binocular body tubes, (inclined or vertical), plain or mechanical stages, (rectangular or circular), substages adapted for every kind of illuminating apparatus and wide choice of objectives and eyepieces make up the different models.

Stability, Balance and Rigidity provide the further essentials of the Research Stand.

Complete details on these instruments are contained in Catalog D-129. Write for it today. Bausch & Lomb Optical Co., 642 St. Paul Street, Rochester, N. Y.

Bausch & Lomb

WE MAKE OUR OWN GLASS TO INSURE STANDARDIZED PRODUCTION

FOR YOUR GLASSES, INSIST ON B & L ORTHOGON LENSES AND B & L FRAMES

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

The Journal of Experimental Zoology

Published by The Wistar Institute

Ross G. Harrison, Managing Editor, Yale University

Vol. 72 *Contents for February, 1936* **No. 3.**

J. M. OPPENHEIMER. Transplantation experiments on developing teleosts (Fundulus and Perca). Twenty-nine figures.

W. R. COE. Sexual phases in Crepidula. Eight figures.

A. PHELPS. Growth of protozoa in pure culture. II. Effect upon the growth curve of different concentrations of nutrient materials. Five figures.

D. E. MINNICH. The responses of caterpillars to sounds.

M. DOUDOROFF. Studies on thermal death in Paramecium.

J. B. LOEFER. Bacteria-free culture of *Paramecium bursaria* and concentration of the medium as a factor in growth. Five figures.

A. MARSHAK. Growth differences in reciprocal hybrids and cytoplasmic influence on growth in mice. Ten figures.

Price $7.50 per volume, Domestic; $8.00 per volume, Foreign

Issued eight times a year

Many early volumes are still available. Prices upon request.

Address subscriptions to

The Wistar Institute of Anatomy and Biology
36th Street and Woodland Avenue
Philadelphia, Pa., U. S. A.

MANUAL OF THE SOUTHEASTERN FLORA

ILLUSTRATED

Being Descriptions of the Seed-Plants growing naturally in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee and Eastern Louisiana

By

JOHN KUNKEL SMALL

THIS Manual replaces the author's Flora of the Southeastern United States, published in 1903 (second edition 1913), for the Southern States east of the Mississippi River. It embodies the results of continued exploration and study, thus bringing up to date our knowledge of this floral region.

The Manual is the only complete illustrated work on the flora of the Southeast by a recognized authority.

In addition to analytical keys to the various plant groups, and descriptions of the orders, families, genera and species, regional or altitudinal and geographic distribution, there are xxii + 1554 pages and over 1500 illustrations, one illustration of a species of each genus.

Price $10.50 Postpaid

THE NEW YORK BOTANICAL GARDEN

Fordham Branch P. O., New York City

SCIENCE

VOL. 83 FRIDAY, JANUARY 17, 1936 No. 2142

The American Association for the Advancement of Science:
The Confusion of Tongues: DR. OSCAR RIDDLE 41
Obituary:
Lafayette Benedict Mendel: PROFESSOR HENRY C. SHERMAN. *Reginald Gordon Harris:* DR. C. B. D.
Recent Deaths and Memorials 45
Scientific Events:
The Kaiser Wilhelm Society for the Advancement of Science; The Adam Seybert Mineral Collection; Annual Report of the Director of the Field Museum; Presentation of the Perkin Medal to Professor Warren K. Lewis 48
Scientific Notes and News 51
Discussion:
Does the "Radio Act" Hamper Research?: PROFESSOR HARRY ROWE MIMNO. *Coffee and Cacao in Southern Florida:* DR. O. F. COOK. *The Similarity between the Mechanism of the Rennin and Pectase (Pectin-methoxylase) Reactions:* DR. A. C. DAHLBERG and PROFESSOR Z. I. KERTESZ. *Iodine in Goiter Treatment:* DR. R. K. SUMMERBELL and FRED D. AYRES. *Genetics, Sulfhydryl and Cancer:* DR. FREDERICK S. HAMMETT 54
Scientific Books:
Atomic Spectra: PROFESSOR G. BREIT 57
Special Articles:
Growth in Height and Weight in College and University Women: ROGER G. BARKER and PROFESSOR CALVIN P. STONE. *Ketene (CH_2=CO): A New Reagent for the Detoxification of Vaccine:* DR. JOSEPH T. TAMURA and DR. M. J. BOYD. *The Orogenic History of Central Utah:* PROFESSOR EDMUND M. SPIEKER 59
Scientific Apparatus and Laboratory Methods:
Petroleum Sprays for Dandelions: DR. W. E. LOOMIS and N. L. NOECKER. *An Apparatus for Automatically Maintaining Reduced Pressure:* C. F. WINCHESTER 63
Science News 5

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE CONFUSION OF TONGUES[1]

By Dr. OSCAR RIDDLE

CARNEGIE INSTITUTION OF WASHINGTON, STATION FOR EXPERIMENTAL EVOLUTION, COLD SPRING HARBOR, N. Y.

THE large brood of zoological sciences has filial concern in an event of just 100 years ago. From October, 1835, to the following January—and from weeks in the Galapagos Islands to the arrival of the *Beagle* in New Zealand—the idea of evolution first came clearly into Darwin's mind. Only after a lapse of nearly 25 years of further investigation did Darwin publish (1859) what he termed an "abstract" entitled, "The Origin of Species by Means of Natural Selection, Or the Preservation of Favored Races in the Struggle for Life." If there are such things as ferments in the sphere of ideas this century-old idea must outrank all others—because of its significance to man and because of what it has already done to synthesize, develop and then to split off the many units or branches of biological science. Just now we may witness the result of 100 years of action of this ferment.

It is not my purpose here to discuss either Darwin's work or the notable later developments in which the geneticist has been able to assist and observe the formation of new species. As a preface to the real theme of this hour I nevertheless ask permission to make some use of this intellectual ferment—first considering its fruitful accelerating action in building and splitting off zoological sciences, some of which have become capable of dealing effectively with questions of great intellectual interest which Darwin's own idea of organic evolution touched only in part or by implication only.

We do well to remember that if the many aspects of the living animal body were now less known, if specialization had not proceeded so far, Section F—the zoological sciences—would now be the natural

[1] Address of the vice-president, Section F (Zoological Sciences), American Association for the Advancement of Science, St. Louis, January 1, 1936.

primitive home of psychology, anthropology and the medical sciences. Thus, four of the sixteen sections of this Association for the Advancement of Science are largely and quite properly zoological sciences. In addition, zoological science shares heavily in the Section for Agriculture; and the incurable optimists among us will perhaps cling to a hope that our science will some day be discovered by the Section for Education. But let us now note one or two points of action of our ferment on some of these sciences, or group of sciences, which have already budded off from the parental body.

That large aspect of anthropology which deals with structure and proportions in human races quickly got a new orientation from its first impact with Darwinism. Immediately following the publication of "The Origin of Species" Sir Richard Owen, renowned professor at Oxford, and his friend, the Bishop of Oxford, poured fine scorn on the Darwinian idea and claimed particularly that the human brain had certain structural features never seen in the brain of anthropoid apes. At the meeting of the British Association at Oxford in 1860 this question was settled for all time by what Keith has called "that spectacular fight in which the Bishop of Oxford left his scalp in Huxley's hands." Not long afterwards Huxley published the necessary details—"The Evidences of Man's Place in Nature"—showing that from the standpoint of anatomy man is not a separate order of being but is properly classed with the primates. This was a quick decision, and thereafter trained intellects everywhere have had a chance for a hitherto unhinted freedom.

The action of our ferment on psychology has been both unique and profound. Unique, because in its earlier days psychology claimed closer kinship with philosophy and metaphysics than with zoological science; but here, in much less than 100 years, the reversible action of the ferment has proceeded with the rebuilding of a science, and modern psychology now leans upon respectable relatives—physics, physiology, animal behavior and neurology. To psychology it was the breath of life to verify within its own field, as had already been done outside of it, the principle that vital processes are natural events, not capricious acts of some supernatural spirit.

Probably nowhere more than in the medical sciences has the Darwinian ferment, with its ardent intellectual awakenings, supplied us with births and rebirths of sciences. To men of a hundred or a thousand years from now it will not seem accidental that the Physiological Society of London was established in 1875—sixteen years after "The Origin of Species" and four years after Darwin's second great contribution, "The Origin of Man." Nor that within a few years or decades after 1859 the sciences of bacteriology, cellular pathology, biochemistry, genetics, endocrinology and nutrition were born; nor again, that within this same period physiology, the several residual zoological disciplines and medical education all took on a new life. At this short distance it would seem that the ferment made more men willing to work with the life-stuff; that the ferment multiplied the results of their efforts; and that the ferment made the laboratory itself begin to live.

In a word, and in a way quite well known to this audience, this ferment—plus the co-ferment offspring which developed the evolution idea into the now established evolution principle—has speeded the coming of new sciences, has made a great contribution to the health and economic power of all later generations of man, and for many educated men in most countries it has swept away fear and superstition and brought quite new conceptions of the origin and destiny of man.

It should now be noted that some risks and liabilities attend the growth, splitting off and specialization of various sciences from the parental body of zoological science. It is unthinkable that the tree shall not possess and profit by the great achievements of two of the branches it has catalyzed to growth and sustained in life; but this profit depends upon firm bonds of attachment of the tree to its branches. If one very specialized discipline wholly monopolizes the most interesting product of the evolution principle, namely, consciousness; and if another specialized discipline wholly monopolizes the field dealing with the origin of life, it is clear that the central core and the disjoined extremities of a common body of knowledge all run one great risk. Unless workers in each of these disciplines retain familiarity with the texture of related thought and progress in the others, they risk failure to grasp the principle of continuity which is at the basis of all facts and of all connected thinking about the phenomena of life. On the one hand this means that the training of men in life-science must not be too narrowly conceived; on the other, it should mean that a text-book of biology or zoology which does not present available data for the origin of the organic from the inorganic and for the evolution principle in its present and broadest meaning—including the origin of consciousness—is omitting or excluding essential elements of modern biological science.

These two questions, the origin of life on the earth and the origin of consciousness in the animal series, require further consideration because they are complementary to Darwin's principle and because they are useful to the main purpose of this address. Darwin did not deal directly with the problem of the origin of life, though the principle which he did so much to establish as holding from the simplest living thing to complex conscious man would have to be broken if living matter did not originate by natural processes

from non-living matter. The very soul of Darwin's conception of evolution was that every organism—simplest or highest—is the resultant of a particular organization of matter existing under and subjected to natural conditions and influences, past and present.

From Darwin's day and somewhat later it has been known that large numbers of inorganic compounds which probably could not exist during very early phases of earth history did come into existence—accompanied almost necessarily by many types of significant inorganic colloids—in epochs preceding the appearance of living things. Some decades ago Gautier showed that simple but very reactive hydrocyanic acid, HCN, on mere standing in water gives rise to many nitrogenous substances found in living matter—such as urea, carbamic acid and alanine. Within the past twenty years, as noted meanwhile by several investigators, it has been definitely proved by Professor Baly and others that formaldehyde, sugars and other organic substances—some of them nitrogen-containing—are generated under conditions which must have prevailed on the earth's surface before, during and after the origin of living matter. The agents necessary to the building of such organic matter are none other than sunlight, ordinary temperatures, colored surfaces, water and carbon dioxide. Moreover, from one such sugar, glucose, in alkaline solution, plus a time factor, some hundreds of different organic substances have already been derived in laboratory experience. With only nitrate or nitrite added to the system already mentioned the very reactive nitrogenous substance, formhydroxamic acid, is formed; and, with additional active formaldehyde this acid combines to form a whole series of compounds which are the commonest constituents of plants and animals—pyridine, purine and α amino acids.

There exists scarcely a doubt that during long periods of earth history, preceding the appearance of living matter, many localized areas of the earth's surface provided suitable conditions for the synthesis of sugar and some amino acids. Thus the natural forces at work on the earth's surface prior to the appearance of living matter had almost certainly already provided a variety of both inorganic and organic compounds characteristically utilized by living matter—including the particular sugar, glucose, from which most living matter still derives an obligatory flow of free energy, and some α amino acids which must serve as building blocks for the protein which is the chief constituent of living matter. These syntheses of organic matter wholly apart from life are facts which must now be utilized in dealing with the question of the origin of life. Any general biological instruction that fails nowadays to direct attention to these facts is vitally deficient in its presentation of modern life-science.

There is a new word to add to this discussion of the borderline between living and non-living substance. For some years it has been fairly evident that the substances or units known as viruses are smaller than any visible cell or organism and that they nevertheless show the one property which is most characteristic of life—that of reproduction. They have seemed part of a bridge between those smaller but lifeless organic molecules which—as we have just noted—form spontaneously at or near the earth's surface (precisely where all known life exists) and those larger molecular aggregates which are bacteria and cells endowed with all the properties of life. Though apparently simpler than known living matter the virus has seemed to fit a biological frame somewhat better than a chemical one. The virus appears to stand nearer to life than to the spontaneously formed sugars and amino acids. Within recent months—only half a year—these earlier indices have been much strengthened and extended by Stanley's successful preparation and study of "A Crystalline Protein Possessing the Properties of Tobacco-Mosaic Virus."

These crystals were found to consist of protein having a molecular weight of a few millions, and thus a much larger molecule than that of egg-albumen. This protein is practically insoluble in water, and it passes a Berkefeld "W" filter. Its chemical composition and its power to infect—that is, its ability to propagate itself—were quantitatively unchanged by 10 successive crystallizations. Its activity was destroyed by peptic digestion; by heating to 94° C.; by alkalinity greater than pH 11.8, and by acidity greater than about pH 1.0. Here we seem to have beautiful facts concerning an *autocatalytic* protein—a protein which will indefinitely build itself anew when given contact with a suitable bit of living tissue, and which then seemingly exhibits only this single characteristic of living matter.

Two further considerations are close at hand. *First:* When we remember that at present there is no possibility of knowing of the existence of molecules similar to virus molecules unless they produce *disease,* we are warned that we have not yet been permitted even half a look into that region which lies between spontaneously formed sugars or amino acids and the higher level represented by the simplest bacteria.

Second: When these properties of the autocatalytic virus protein are compared with the known and probable properties of the *gene* we find parallels which can hardly be fortuitous—and possibly we here encounter other planks for that bridge leading from spontaneously formed organic molecules to those molecular aggregates (protoplasm) which are fully endowed with life. Let us first note that both the virus molecule and the gene are known to have the capacity to duplicate themselves exactly. Also that in every known instance for both of them this duplication

occurs only when these molecules are in intimate contact with more complex molecular aggregates which show *all* the properties of life. Indeed, in a genic system it has been shown that the absence or malformation of a particular gene may so alter or terminate autocatalysis in the associated genes (or entire cells) as to result in the death of the cell or organism. Again, there is strong presumptive evidence that the gene is a single molecule and that it is a protein molecule. It is practically certain that the various genes (or rather the various pairs of genes) associated in a cell have at least slight molecular differences, and such differences quite certainly exist among the different types of virus. The limits at which, and the means by which, the virus molecule is disabled are of the type and general order of magnitude that we might reasonably expect of some protein gene molecules if good fortune permitted our making suitable tests upon them. Finally, both genic and virus molecules defy the highest powers of the microscope, and they may differ neither greatly nor consistently in size.

These parallels require still a further word. Several years ago Duggar first, and later Müller, drew attention to ways in which the virus is like a gene got loose from its companion genes; and, by its power to reproduce, is creating disturbance—the virus disease in other cells of the host. In my opinion further knowledge of both virus and gene has made it rather improbable that the virus is an escaped gene, and I venture the suggestion (a) that some of the similarities of virus and gene rest upon the circumstance that a gene standing alone can not be considered as fully alive; (b) that the commonly observed property of the gene molecule to suppress its own reduplication over long periods, and to correlate closely in time such later duplication with the occurrence of the same thing in all associated genes, is apparently a more advanced biological property than that observed in any virus molecule; and finally (c) that the virus molecule is apparently more free than the gene to obtain its stimulation to reduplication from living substance with which it has had no previous contacts or association.

I ask the privilege to develop this suggestion briefly. When matter is considered at the biological level it is organization and interaction of organic molecular aggregates that is of first importance. Just as in the case of inorganic compounds, we must conceive the properties of living matter as more than the sum of the properties of the separate component (atoms or) molecules. Quite new properties certainly come with each new combination; and, in a microscopic bit of protoplasm not only does the probable number of combinations still elude us, but we are assured that the organization and free interaction of parts is presenting us with that which is truly biological. How then could we be justified in considering any single individual *gene* as necessarily more alive, or more nearly alive, than the protein molecule which is a virus? Does the increase in "liveness" issue from the *aggregation* (and organization) of several chemically *different* genes—each individually having power to reproduce itself under proper contacts—with aggregation of genes (along with other simpler molecules supplying matter and energy) automatically providing much or most of the requisite conditions of contact? If this should prove true, or partly true, it would mean that the bridge of which we have spoken has less length than we have imagined. The longest single missing span may be that reaching from spontaneously-formed sugars and amino acids to a protein molecule like that of a virus.

Studies of the past thirty years on the structure and functions of the brain, and on the relation of other parts of the body to brain function, have resolved but a fraction of the primary problems of the mind. But the mind has been firmly placed in an evolutionary frame, and several gaps in our knowledge formerly filled by myth or magic have been displaced by verifiable experience.

For nearly all competent investigators of life phenomena the Cartesian philosophy of duality of mind and body has, like Noah's ark, sailed out of the picture. Or, shall we say that while immersed in the Darwinian ferment during a few decades the experience of physiology, animal behavior, neurology and psychology has yielded crystals of a common kind—these crystals having been shown to be composed of body-mind, not of body *and* mind. The consciousness of dog and man has evolved, and redevelops in every ontogeny, in the same unbroken way that the function of the digestive or glandular system has evolved. The evidence on this important point to-day is probably stronger than that adduced in 1859 for the principle of evolution. Consciousness, as well as some related subconscious phenomena, is associated with organization at a high biological level and chiefly though not solely with organization of the brain.

Permit me to cite two recently found means by which somatic or extra-neural elements may affect the mental product—in one case quantitatively, the other qualitatively. *First:* Both Hindzé and Donaldson find evidence that well-developed pial blood-trees go with the brains of able men, while such blood supply tends to be less to the brains of those whose performance in life indicated less mental ability. *Second:* During the past year studies alone with colleagues in my own laboratory have shown that the incubation and maternal instinct—as this occurs in fowl and virgin rats—is released or mediated by the anterior pituitary hormone, prolactin. The hormone acts in a now unknown way on nerve and brain function. But instincts are recognized as basic elements from which

intelligence or consciousness arose and arises; and in this case the instinct normally appears only near the end of growth and development—where it is most accessible to study. In these otherwise fully equipped animals the birth of this instinct awaits and requires the cooperation of the hormone. It is thus found that a hormone, a thing of somatic origin, shares in bringing a new element of consciousness into the body-mind of these animals.

It will now be useful to turn for a moment to our ancestral zoological tree with a view to tagging a few of those branches which it has added to itself within the short span of 30 or 35 years. One such tag reads "genetics," and this branch has already ripened some fine fruit: First, that all men are created *un*equal. No politics or poetry or dogma in this; just a straight clean fact of prime importance to decent thinking on human social problems; and possibly a fact that must be learned, digested and assimilated by the great majority of men—particularly in democracies—before unreason ceases to be a threat to all forms of democratic government. Second, a single gene can produce feeblemindedness. Here is found not only a nexus of body and mind, but mental development is seen to depend upon the same pill-box of genes that decides the color of our skin or our degree of resistance to diabetes. Third, changes within the gene and genetic system of just the types apparently required for progressive evolution, and on which natural selection can work, have been witnessed and analyzed. The origin of some species by natural means has now been attested by controlled observation. Thus, it is nowadays the *phenomenon* of evolution that intelligent men study and describe; and nowadays only a brain moving in reverse bogs down on a question of its reality.

Another new branch of the tree of zoological science is labeled "nutrition." A first flower or fruit on this branch reveals that the growth and well-being of our bodies require no fewer than eleven inorganic elements —those age-old ancestors of the first organic matter whose continued interaction with such organic stuff probably produced the first life—and, in addition, we require not fewer than twenty-three rather simple organic compounds, most of which can not be formed in our own tissues but must be obtained from the less evolved plant world. Second, several human diseases can be cured, and better still they can be avoided, as a consequence of this new knowledge. The fruit from this branch, grown within 30 years, has already endowed our generation with beautiful victories of the laboratory, and all later generations of civilized man with somewhat better health, fuller growth—and even a firmer grip on their teeth. We pause to note, however, that these great values—like those from most branches of life-science—are potential only. Whether these good cheques are turned into the gold of better health, greater happiness and more effective living depends primarily upon their being brought to all youth by elementary and secondary education.

Among the other new branches of this tree we here remark only another one, called "endocrinology." Not all the fruits on this new branch are ripe, but let us here taste of two that are. *First:* It has been shown that the ductless glands share largely with the nervous system in regulating those several complicated processes—development, growth and the maintenance of active, healthy bodily states. Nervous regulation and hormonal regulation form a superb partnership which permits existence at a human level. The manifold duties and talents of the endocrine partner are known to share largely in determining our strength, our diseases and our outlook upon life. *Second:* All or nearly all the main elements in the normal hormonal control of mammalian and human reproduction are now known, though fifteen years ago not one of the several hormones chiefly concerned had been separated or assayed. The women of the first human generation that could possibly know or learn the basis and meaning of the cycles and reproductive adjustments which are peculiarly theirs are the women and girls now with and beside us.

(*To be concluded*)

OBITUARY

LAFAYETTE BENEDICT MENDEL

DR. LAFAYETTE BENEDICT MENDEL, Sterling professor of physiological chemistry in Yale University, died on December 9, 1935, after an illness of eighteen months.

He was born at Delhi, New York, on February 5, 1872, and received both his undergraduate and graduate training at Yale, where he was awarded the degree of A.B. in 1891, and that of Ph.D. in 1893. He was a member of the Yale staff continuously from the age of twenty: Assistant in physiological chemistry, 1892–94; instructor, 1894–97; assistant professor, 1897–1903; professor since 1903, and Sterling professor since 1921. On leaves of absence, he worked at Breslau and Freiburg in 1895–96, traveled and lectured widely in subsequent years, and served on the Inter-Allied Scientific Food Commission during the world war.

Always a Yale man, he was both a product and a builder of the institution of which he saw the emergent evolution, from a rather conservative college with a

loosely connected scientific school and an even less integrated and then-little-known school of medicine, to a great modern university, coordinated, progressive and distinguished throughout. His prompt selection for the exceptional honor and opportunity of one of the then newly established Sterling professorships, and his long-continued appointment to the governing boards of the university graduate school and the university library, as well as to those of the schools of medicine and science and to the directorship of his own and often of related departments, were among the intra-mural recognitions of his distinguished scholarship, his wise and conscientious administration, his indefatigable spirit of service, his steady habit of broadly constructive, unifying, hard work. As was said at his funeral in Battell Chapel, in his passing his university has lost one of its most commanding and influential spirits, and the world of science is bereft of an outstanding leader.

So great and so personal is the loss, not only to his students and his immediate colleagues but to the host of scientific friends, whom also he generously called colleagues and who as laborers in the same great field were inspired by his example and largely guided by his wise judgment, that it may be too soon for an entirely objective evaluation of his career and contribution. It is probably also, and more importantly, true that any attempt at any time to appraise his life and work in merely objective terms would fall far short of showing its true significance. Here, we might well be content with a very incomplete sketch of the outward evidences of his accomplishment, if also we could glimpse even a little of its inner and enduring spirit.

He published an influential book, "Nutrition: The Chemistry of Life," based on his five Hitchcock Lectures at the University of California and summarizing briefly some different aspects of nutrition from the view-point of 1923; also a number of shorter and more specialized summaries; and about three hundred research papers, many of which are joint contributions by himself and coworkers.

His research bibliography, like the record of his academic service, shows the breadth of his mind and the generosity of his spirit of cooperation. He was alert to utilize the special opportunities of his place and time, not for personal prestige but for his official family, his university and for the advancement of science. And imperturbably he followed his own inner oracle without too much anxiety as to passing fashions in research or as to questions of priority and originality. Without discussing it, he lived the principle that originality consists in thinking for oneself, not in thinking differently from other people. And to recall his coworkers in research is to realize anew how unselfishly and openmindedly he served the advancement of science, with equal readiness making himself a junior partner to Chittenden or Osborne, or taking into partnership a student to whom he would painstakingly teach the very first rudiments of research procedure.

Equally noteworthy is the large number of highly productive careers in research which began thus under Dr. Mendel's guidance. For not only had he trained himself to high facility in the technique of his subject, especially on its more physiological side; he also gave his students an introduction to research which comprised more than merely instruction, demonstration and direction. To work with Dr. Mendel meant something more, and did something deeper and permanent, to the beginning and developing researcher than to be directed by any professor (however learned) who lacks the sanely and wholeheartedly sympathetic attitude which Mendel had consistently cultivated and developed in himself. Also, it meant more to the student than any amount of mere intimacy and elbow instruction which lacks the backing of broad reading in the literature of the subject, and deep reflection upon its problems.

Mendel's knowledge of chemical physiology and especially of nutrition was both broad and deep, and so was his research contribution. Because of the breadth of his interests and reading, he was accustomed to offer his advanced students a wide range of research topics and as often as possible to accede to the desire of the student that Dr. Mendel be a partner in the research. From these partnerships there resulted contributions to widely diversified sectors of the advancing front of physiological chemistry and chemical physiology. At the same time his research jointly with T. B. Osborne upon proteins and vitamins was highly intensive and deeply fundamental. Their experimental correlation of the amino-acid constitutions of different proteins with the functions and efficiencies of these proteins in nutrition will long remain one of the outstanding landmarks in either a chemical or a physiological survey of modern science. Their investigations of vitamins were also of outstanding significance. Dr. Mendel also contributed largely to the critical literature of growth.

Believing strongly in the importance of the orderly recording and adequate dissemination of the findings of research, he gave generously of his time and thought as member of the editorial boards of the *Journal of Biological Chemistry*, the *Journal of Nutrition* and the *Scientific Monograph Series* of the American Chemical Society; and as an unofficial contributor to the editorial pages of the *Journal* of the American Medical Association.

While his life-long habit was one of unselfish service

and entire willingness to submerge himself in the larger interests for which he worked, yet the world of science did not fail to recognize his great contributions to knowledge, and the noble, self-disciplined, unspoiled character which kept his mind open and his judgment unbiased.

He was the recipient of honorary degrees from Michigan, Rutgers and Western Reserve Universities; of the gold medal awarded by the American Institute of Chemists for noteworthy and outstanding contributions to chemistry; and the Conné medal for outstandingly meritorious chemical service to medicine.

On his sixtieth birthday his former students from far and near gathered to do him honor; presented his portrait to the university; and filled, with papers on important branches of science in which they are recognized authorities, a special number of the *Yale Journal of Biology and Medicine*, which was dedicated to him.

He was a member of the National Academy of Sciences; research associate of the Carnegie Institution of Washington; past-president of the American Physiological Society, of the Society of Biological Chemists and of the American Institute of Nutrition; and an officer of several other scientific and professional organizations; member of the Council of Pharmacy and Chemistry of the American Medical Association and of its Committee on Foods, and of many other boards, commissions, committees and councils; and, as well, he was official adviser on scientific research to the United States Department of Agriculture as well as unofficial but none the less influential adviser and trusted councilor of innumerable organizations and individuals in the field of pure science, the professions of medicine, dietetics and home economics, and in the world of practical affairs especially as bearing upon the food industries. He had so thoroughly established both the habit and the reputation of well-balanced scientific judgment that his advice was much sought in many difficult problems; and as a result of the self-discipline of a life-long devotion to science he could share the confidence which others felt that his judgment would remain unbiased whatever the economic interests involved.

That he did not need to isolate himself from the world of affairs in order to maintain his intellectual integrity; that his institution, while recognizing and prizing his scientific productivity, yet constantly drew heavily upon his time for administrative functions because his wisdom and justice were so highly esteemed by those who knew him best; that he continued to give such generous service in so many directions even after, as he told me some years ago, he "had discovered the importance of the principle of the conservation of the individual"; that while often over-busy his considerateness was never-failing; that he personified the principle of *noblesse oblige* and was held by his students in a literally ineffable esteem: were these the results of merely fortuitous "gifts" of separate scientific and spiritual qualities to the same man? One ventures to hope that there is more than coincidence here. His example, with the evidence of his inspiring and enduring influence, suggests that as science outgrows the over-confidence and the too-mechanical point of view of the past three or four generations, the cultivation of the true spirit of science may minister directly to the growth of those qualities of character which have made Dr. Mendel's life and work at once a service to the whole human race and a personal inspiration to all who were privileged to know him.

HENRY C. SHERMAN

REGINALD GORDON HARRIS

DR. REGINALD G. HARRIS, director of the Biological Laboratory of the Long Island Biological Association since 1923, died on January 7, 1936, at the Huntington Hospital of pneumonia. Dr. Harris was born in Medford, Massachusetts, on July 18, 1898, the son of Benjamin R. and Adella (Wilder) Harris. His father was a Baptist clergyman of Massachusetts and his mother came from Vermont—thus Dr. Harris was a product of Puritan New England.

Under Dr. Harris's administration, the Biological Laboratory advanced from the status of a summer school of biology to a leading center of research in biophysics and physiology. The most striking feature of the work of the laboratory in recent years has been the series of symposia on quantitative biology in which have cooperated chemists, physicists and mathematicians with biologists. The results of these symposia are published in three large volumes which have been called for by leading libraries and learned men of all civilized countries.

The success of Dr. Harris's work depended largely upon certain prevailing personal traits. Among these were a love of travel in the wild, not merely for travel's sake but to meet peoples of primitive culture. These he met on such terms that they became his fast friends. While at Darien looking up "White Indians" he and his wife were invited to sojourn on an island from which whites had hitherto always been rigorously excluded. He studied at the University of Algiers, he traveled across South America, collecting rare insects, he traveled in Panama, Brazil, Peru, Yucatan, Guatemala, Colombia.

His broad imagination gave rise to new ideas and his administrative ability enabled him to realize them. Thus, his was the great idea of bringing together the physicists, chemists, mathematicians and biologists for exchange of ideas in their fields where these sciences make contact. This idea appealed to the supporters

of the laboratory and was developed during three summers at Cold Spring Harbor with great practical results.

During his administration he ran the business of the laboratory smoothly, not only as director but also as assistant treasurer and assistant secretary. His administrative ability appealed to business men of means. He was able to meet the wealthy contributors to the work of the laboratory as easily as he could meet primitive peoples in their natural countries. With nothing human was he out of contact.

Personally, he was slender, lithe, with a walk that was alert and springy. Having a direct approach, he inspired confidence and loyalty. With his active and understanding mind he could lead discussion on almost any biological paper that had been delivered. His presentation of the needs of the laboratory before the board of directors was a model, not too detailed to bore, but enough to interest the intelligent listener. He got the board to become biologically minded. His fine presence and agreeable manners excited such confidence that he was unusually successful at the difficult task of securing support for the laboratory in time of depression.

C. B. D.

RECENT DEATHS AND MEMORIALS

PROFESSOR ROBERT FLETCHER, since 1871 until his retirement in 1918 with the title emeritus director of the Thayer School of Civil Engineering at Dartmouth College, died on January 7 at the age of eighty-eight years.

MISS ANNA MARGUERITE PABST, junior bacteriologist at the National Institute of Health of the United States Public Health Service, died on Christmas Day from meningococcus meningitis. For the last five years she had been taking part in studies being done in the institute on this disease. On December 17, while she was immunizing a rabbit in order to prepare a serum for laboratory use, the animal jumped and some of the culture she was injecting spurted into her eye. She became ill suddenly on December 21 and died four days later.

DR. F. B. ALLAN, professor of organic chemistry and dean of the faculty of arts at the University of Toronto, died on January 9 at the age of sixty-eight years.

DR. CARL W. FISHER, who had been in veterinary practice in San Mateo, Calif., for the past thirty-four years, died on November 26. A correspondent writes: "During the years of his practice Dr. Fisher achieved success not only in the treatment of diseases but particularly in disease prevention. His success in developing and maintaining herds free from infectious diseases has long been recognized. The efficiency and sincerity of his work is held in high esteem by his veterinary colleagues throughout California."

A MEDALLION has recently been affixed to the house at Confolens in the Department of Charente, in which the late Dr. Emile Roux, the director of the Pasteur Institute of Paris, was born.

A MEMORIAL exhibition was opened on December 20 at the Science Museum, London, which will last till April 19 to commemorate the bicentenary of the birth at Greenock on January 19, 1736, of James Watt, the engineer and inventor. Many objects are shown, including three original beam engines, two of which were erected in Soho Manufactory in 1777 and 1788, respectively, and the third in London in 1797, and various original experimental models, including the separate condensers of 1765 which led to his most important contribution to the development of the steam engine. The Garret Workshop, where Watt frequently worked from 1790 till his death in 1819, and which was moved with its contents from Heathfield Hall, near Birmingham, to the Science Museum in 1924 for permanent preservation, will be on view. A large number of drawings, some by Watt himself, have been lent by the Birmingham Public Libraries Committee and form a detailed survey of the progress in steam-engine design from 1775 to 1800, the period of Watt's partnership with Boulton. There are also numerous portraits of Watt, Boulton and their scientific friends which have been lent for the occasion by the National Portrait Gallery, the Victoria and Albert Museum, the Royal Society, the City of Birmingham Art Gallery and others.

SCIENTIFIC EVENTS

THE KAISER WILHELM SOCIETY FOR THE ADVANCEMENT OF SCIENCE

THE Kaiser Wilhelm Society for the Advancement of Science, Berlin, celebrated on January 11 the silver jubilee of its foundation by the German emperor twenty-five years ago.

In an account of the proceedings given by Otto D. Tolischus, correspondent of *The New York Times*, it is stated that the society has now 675 members; it controls thirty-four separate institutes, in which research is carried on by 1,100 investigators.

The official celebration opened with a reception by Dr. Julius Lippert, State Commissar for Berlin, in the City Hall, followed by a festive jubilee session in Harnack House. At the reception the Hitler bodyguard band provided music and Dr. Lippert in ad-

dressing the society spoke of it as "the general staff of German science in our peaceful campaign for the spiritual, cultural and material development of our people."

At the "festive session" Professor Max Planck, president of the society, reviewed its work and two scientific papers were read by members. The session was attended by representatives of the government, party and army as well as of industry and science, but of the Cabinet members only Baron von Neurath, Foreign Minister, and Dr. Hjalmar Schacht, Minister of Economics, were present. To Chancellor Hitler was sent a telegram saying:

> Science and business stand loyally by the German Reich that you created, knowing that only under your leadership and the protection of the armed forces can they perform useful work.

To this Chancellor Hitler replied with greetings and best wishes. Bernhard Rust, Minister of Education, regretted he could not be present but also sent good wishes and promised to attend the jubilee banquet.

The *Times* states that in his review Professor Planck expressed sincere thanks to the government for recognizing the society's importance and furthering and protecting its work, but in opposition to the collectivist tendencies displayed by National Socialists he also proclaimed the independence of science and the liberty of the individual investigator whose tasks, he insisted, could not be performed by state institutions.

He said:

> New scientific ideas never spring from a communal body, however well organized, but only from the mind of the individual, divinely inspired research worker, who wrestles with his problems in lonely thought and concentrates all his powers on the single point, on which for the moment he focuses his entire world.

Mr. Tolischus continues:

> Professor Planck also announced a congratulatory telegram had been received from the former Kaiser and that thanks had been wired to him in return. Likewise, he paid tribute, among others, to the late Professor Fritz Haber, Nobel Prize winner and inventor of the synthetic nitrate process that enabled Germany to carry on during the war, but whom the National Socialist anti-Jewish campaign drove into exile and suicide, and to the late Franz von Mendelssohn, another Jew, who was the society's treasurer until his death in June of last year.
>
> For, contrary to the general impression, the Kaiser Wilhelm Society has refused to introduce the "Aryan clause," whereby even small-town tennis clubs have to expel their Jewish members. The society has lost quite a number of Jewish members and collaborators, of whom Professor Haber was and Dr. Albert Einstein now is the most famous.
>
> But the society prides itself on the fact that it never expelled anybody and that its losses were never due to any action of its own, but to forces beyond its control. As a matter of fact there are still many scientists of Jewish antecedents working with the society, for whom it is a haven of refuge after their expulsion from German universities.

THE ADAM SEYBERT MINERAL COLLECTION

THE first mineral collection formed in America, made in the 1790's by Dr. Adam Seybert of Philadelphia, has been put on exhibit in the Free Natural History Museum of the Academy of Natural Sciences of Philadelphia. This "beginning of mineralogy" in the United States contains 1,725 specimens of rocks and crystals, and is shown in the original cabinet built for it by Dr. Seybert, and as he arranged it.

The exhibit is doubly interesting because it also marks the beginning of the academy, the oldest institution of its kind in this country, which was founded a hundred and twenty-four years ago. On the evening of January 25, 1812, the six founders met in John Speakman's apothecary shop. In anticipation of the organization of the academy, Mr. Speakman had purchased the Seybert collection for $750, a large sum in those days. Shares of $20 were issued to reimburse him for the expenditure, and the effort to pay off this indebtedness helped to keep the academy group together.

Soon after the formal organization of the institution on March 21, 1812, a small room was hired over a milliner's shop at 121 North Second Street. There the collection was installed as the feature of the new museum, and Dr. Gerard Troost, first president of the academy, delivered a course of lectures on mineralogy.

Dr. Seybert was America's first mineralogist. While a student in Paris and Göttingen, he had accumulated a fine mineral collection, into which he incorporated the specimens described in his catalogue of some American minerals which are found in different parts of the United States. This catalogue is included in the exhibit.

Some idea of the importance of this pioneer collection may be gained from the fact that a few years prior to its purchase for the academy, Benjamin Silliman, newly appointed professor of chemistry and natural history at Yale College, had journeyed by stage-coach from New Haven to see the Seybert collection. On arriving in Philadelphia he engaged lodgings at Mrs. Smith's, whose house, occupying the triangle at Dock and Walnut Streets, was frequented by Connecticut members of the congress and by Robert Hare, Horace Binney, John Sargent, George Vaux and Elihu Chauncey.

Silliman had brought with him, in a small candle

box, the entire mineral collection of Yale College—a lot of unlabeled stones. Box under arm, he trudged past the markets of High Street to the shop of Seybert, chemist and mineralogist, at 168 North Second Street, to have them named. And he went back with the desired information.

In his catalogue forty different minerals in the collection were described. He told of a "radiated zeolite found investing hornblende rock, on the canal near the river Schuylkill, about three and a half miles from Philadelphia." Further, "I have some specimens of marble found in York County which approach those allowed to be the pride of Italy." He announced, in 1806, the occurrence of "sulphuret of zinc" (zinc blende) near the Perkiomen Creek, in Montgomery County, and demonstrated that it would yield zinc metal, resulting in the opening of the Perkiomen mines.

Most of the specimens, however, are from Europe. They are small in size, and single crystals are neatly mounted on small wooden plaques. All are ticketed with numbers referring to the manuscript catalogue.

There is a specimen of celestite, the sulfate of strontium, a species first described from Blair County, Pennsylvania. There are specimens from the mines of Cornwall, England—some of which have not been worked for 150 years; Iceland spar from Iceland; two specimens of cryolite from Greenland; "elastic sandstone" from Brazil, and spinel and silicates in blocks of limestone ejected by Vesuvius.

ANNUAL REPORT OF THE DIRECTOR OF THE FIELD MUSEUM

IN a review by Dr. Stephen C. Simms, director of the Field Museum of Natural History, it is stated that more than 1,172,000 visitors were received at the museum during 1935. Of the visitors, only about 53,700, or less than five per cent., paid the 25-cent admission fee charged on certain days; all the rest, approximately 95 per cent., either came on the free admission days, or belonged to classifications such as children, teachers and students, who are admitted free.

Although it was again necessary, as it has been for several years past, to conduct the institution on a budget very much curtailed as compared to what was formerly considered normal, all services with which the public is directly concerned were maintained in full. Internal economies were effected in all departments and divisions, and expeditions for collecting new material and scientific data were eliminated from the program of activities for the year. Through special funds provided by Mrs. Emily Crane Chadbourne, the museum was enabled to obtain some zoological specimens collected by an Arctic expedition led by Captain Robert A. Bartlett; and the marine life collections were enriched by a share of the collections made by the South Seas Expedition of the John G. Shedd Aquarium.

Largely from an accumulation of stored specimens obtained by expeditions in previous years, the museum installed many new exhibits. New zoological exhibits include habitat groups of nilgai or blue bull of India; snow leopards of the Himalayas; common leopard of Asia; Axis deer and the antelopes known as blackbuck and chinkara from India; elephant seals from Guadalupe Island, Mexico, and various important new series of birds and reptiles. In the paleontological division of the department of geology several especially rare and important large skeletons of prehistoric South American animals were installed, including the only known complete specimen of *Astrapotherium magnum*, and what is probably the only complete specimen of *Megatherium americanum* in any North American museum. The department of botany completed a detailed miniature reproduction of a Brazilian coffee plantation and a number of new reproductions of exotic plants for the series in the hall of plant life. Outstanding among new exhibits in the department of anthropology were reconstructions of ancient graves of prehistoric inhabitants of Peru, and a model of the great Toltec pyramid of Quetzalcoatl in Mexico.

All educational activities, both intra-mural and extra-mural, were continued without curtailment. The library of the museum, with its collection of 100,000 volumes on natural history, and the study collections of specimens maintained in the departments, continued to serve the public, especially large numbers of students, teachers and scientific men. From the Field Museum Press there was a large output of scientific publications for international circulation.

The museum continued, as it has since 1933, cooperating with governmental relief agencies by providing useful avenues of employment for workers assigned by the Illinois Emergency Relief Commission, during the earlier part of the year, and by the federal Works Progress Administration, in the latter months. At the end of the year there was a total of 186 WPA workers at the museum engaged in a wide variety of tasks ranging from common labor to research projects. However, regular employees on the museum's payroll continued with their usual duties, and the work done by the relief assignees was all of a character which could not be undertaken by the regular staff because of the pressure of more urgent work.

PRESENTATION OF THE PERKIN MEDAL TO PROFESSOR WARREN K. LEWIS

THE Perkin Medal for 1936 was presented on January 10 to Professor Warren K. Lewis, professor

of chemical engineering at the Massachusetts Institute of Technology, at a meeting of the American Section of the Society of Chemical Industry, held at The Chemists' Club, New York City. The meeting was held jointly with the American Chemical Society. Dr. George A. Burrell, of the Burrell-Mase Engineering Company, gave a short talk on the subject of the medalist and Professor Marston T. Bogert, of Columbia University, made the presentation. Professor Lewis gave the medal address entitled "Application of Physical Data to High Pressure Processes." He spoke about the use of high pressure in modern chemical industry, as in the syntheses of ammonia, the aliphatic alcohols and phenol, the hydrogenation of coal and oil and the separation of mixtures by both absorption and rectification.

Warren K. Lewis was born in 1882, in Sussex County, Delaware, and graduated in chemical engineering from the Massachusetts Institute of Technology in 1905. He served one year in that institute as laboratory assistant in industrial chemistry, after which he studied for two years in Germany, taking his doctor's degree under Abegg and Ladenburg at the University of Breslau. In 1909 he became chemist for a tannery and leatherboard mill. A year and a half later he returned to the Institute of Technology as assistant professor of industrial chemistry and has been on its faculty continuously since that time. During the war, first in the Bureau of Mines and later in the Chemical Warfare Service, he had charge of research on gas defense.

Throughout his career as a teacher of engineering Professor Lewis has maintained close contact with the vital problems of industry, largely through consulting activities, and has endeavored not only to develop solutions of these problems in the laboratory, but even more to train in the classroom men with the power to solve them. His work has focussed mainly on filtration, distillation and absorption, the thermal properties of materials and the chemistry of colloids and amorphous materials.

SCIENTIFIC NOTES AND NEWS

THE William H. Nichols Medal for 1936 of the New York Section of the American Chemical Society has been awarded to Dr. William Mansfield Clark, professor of physiological chemistry in the Johns Hopkins University, for researches characterized as "of incalculable value to human welfare."

DR. ARTHUR E. KENNELLY, professor emeritus of Harvard University and of the Massachusetts Institute of Technology, has been notified by the Société Française des Electriciens, Paris, that he has been granted the 1936 Mascart Medal of that organization. The medal is awarded triennially for distinguished service in either basic or applied electricity.

DR. JOEL H. HILDEBRAND, professor of chemistry at the University of California, has been elected faculty research lecturer for 1936. This appointment is the highest recognition that the faculty can give to one of its members. Professor Hildebrand will give the annual research lecture during the week of Charter Day, which falls on March 23.

THE list of British New Year's honors includes knighthood conferred on Dr. Arthur Harden, emeritus professor of biological chemistry at the University of London, and on Dr. David Percival Dalbreck Wilkie, professor of surgery at the University of Edinburgh.

DR. JAMES B. AYER, James Jackson Putnam clinical professor of neurology, Harvard Medical School, was honored recently at a dinner at the Tavern Club, in recognition of his completion of twenty-five years of teaching at the medical school. Dr. Charles Macfie Campbell acted as toastmaster, and brief speeches were made by Drs. James H. Means, William Jason Mixter, George L. Walton, Merrill Moore and Henry R. Viets.

THE Distinguished Service Award of the National Council of Geography Teachers was this year conferred upon Dr. Douglas Clay Ridgley, of Clark University, in recognition of his services to educational geography through years of teaching and many publications. Previous recipients of the award are the late William Morris Davis, Professor R. H. Whitbeck, of the University of Wisconsin, and Dr. A. E. Parkins, of Peabody College. The award for distinguished service in the field of educational geography is conferred from time to time upon persons who have made outstanding contributions in the field.

Nature states that at a meeting of the Harrison Memorial Prize Selection Committee, consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry and the Pharmaceutical Society, held on December 12, the award of the Harrison Memorial Prize for 1935 was made to Dr. Leslie Ernest Sutton. The presentation of the prize will be made at the annual general meeting of the Chemical Society to be held at the University of Bristol on April 16.

THE Botanical Society of America, at its thirtieth

annual meeting, which was held from December 31 to January 2, elected the following officers for the ensuing year: *President,* C. Stuart Gager, Brooklyn Botanic Garden; *Vice-president,* H. A. Gleason, New York Botanical Garden; *Treasurer,* F. E. Denny, Boyce Thompson Institute for Plant Research; *Member of the Editorial Board of the American Journal of Botany,* C. E. Allen, University of Wisconsin. Chairmen of the sections of the society elected or announced at the meeting are: General, R. F. Griggs, George Washington University; Physiological, A. J. Heinicke, Cornell University; Systematic, S. F. Blake, Bureau of Plant Industry. Corresponding members elected were: Dr. N. E. Svedelius, professor of botany and director of the Botanic Gardens, University of Uppsala; Dr. A. B. Rendle, lately keeper of botany, British Museum (Natural History); Dr. Fritz von Wettstein, director of the Botanical Institutes and professor of botany, University of Münich, and Dr. N. A. Maximov, professor at the Union Institute for Grain Husbandry, Saratov, U.S.S.R.

AT the St. Louis meeting the Genetics Society of America elected the following officers: *President,* P. W. Whiting, University of Pennsylvania; *Vice-president,* L. J. Stadler, U. S. Department of Agriculture and the University of Missouri. The secretary of the society is Dr. M. Demerec, the Carnegie Institution of Washington, Cold Spring Harbor, N. Y.

AT the thirty-second annual meeting of the Association of American Geographers, which met at Washington University, St. Louis, from December 29 to January 1, the following officers were elected: *President,* Professor W. H. Hobbs (emeritus), University of Michigan; *Vice-president,* Dr. John K. Wright, librarian, American Geographical Society; *Secretary,* Professor P. E. James, University of Michigan; *Treasurer,* Professor John E. Orchard, Columbia University; *Councillors,* Claude H. Birdseye, U. S. Geological Survey (one year); Professor R. J. Russell, Louisiana State University (three years).

AT Princeton University Professor Robert Scoon, chairman of the department of philosophy, a member of the faculty since 1915, has been appointed Stuart professor of philosophy to fill the chair left vacant since the retirement in 1932 of the late president, John Grier Hibben. The McCosh professorship in philosophy has been given to Professor Edward G. Spaulding, a member of the faculty since 1905. This chair was left vacant by the retirement last June of Professor Roger B. Johnson. Dr. Erling Dorf, assistant professor of geology, has been appointed to the new post of curator of paleobotany, while Dr. Glenn L. Jepsen has been made curator of vertebrate paleontology, a post previously held by the late Professor William J. Sinclair.

DR. NEIL E. STEVENS, chief pathologist of the Bureau of Plant Industry, of the U. S. Department of Agriculture, has accepted the position of professor of plant pathology in the department of botany of the University of Illinois, made vacant through the death in 1934 of Professor Frank L. Stevens, who had held the position for twenty years. Dr. Stevens will take up the work at the beginning of the second semester.

DR. HOWARD M. CLUTE has been appointed professor of surgery in Boston University School of Medicine and chief of the surgical service of the Massachusetts Memorial Hospitals, succeeding Dr. Ralph C. Wiggin.

DR. LAWRENCE WELD SMITH, formerly associate professor of pathology, Cornell University Medical School, New York, has been appointed professor of pathology at Temple University School of Medicine to succeed the late Dr. John I. Fanz.

THE title of emeritus professor has been conferred by the University of Leeds on Professor W. H. Lewis, head of the department of chemistry.

The British Medical Journal reports that Dr. P. Manteufel, professor of hygiene at Düsseldorf; Dr. Fritz Specht, professor of laryngology at Erlangen, and Dr. H. v. Haberer, professor of surgery at Cologne, have been nominated rectors of their respective universities. The *Journal* also notes that with the exception of Louvain, all the Belgian universities now have a medical man as their rector, Professor A. Dustin, of Brussels, having been the last to be elected.

A FELLOWSHIP which will allow two years of graduate study in the Metals Research Laboratory of the Carnegie Institute of Technology, Pittsburgh, has been established by the Molybdenum Corporation of America. It has been awarded to Coolidge Alexander Karns, a graduate of Gettysburg College and formerly metallurgist with the Republic Steel Corporation, Buffalo. He will study the application of tungsten in alloys. Last year the Aluminum Company of America made a similar award.

DR. SIMON FLEXNER, director emeritus of the Rockefeller Institute for Medical Research, has been reappointed by Governor Lehman as chairman of the New York State Public Health Council. New members of the council are: Dr. Clayton Greene, of the College of Medicine, University of Buffalo, and Dr. George Baehr, of New York City. Dr. Herman G. Weiskotten, dean of Syracuse University, has been appointed to succeed Dr. Frederick Fuller Russell, of Brooklyn, resigned.

THE *Journal* of the American Medical Association reports that Dr. Jacob Kasanin, clinical director of the Rhode Island State Hospital for Mental Diseases,

Howard, R. I., has been appointed head of the department of psychiatry of Michael Reese Hospital, Chicago.

PROFESSOR YAS KUNO has accepted election as a member of the International Committee of the Physiological Congresses. For many years Professor Kuno was director of the laboratory of physiology at Mukden and has a wide acquaintance with Chinese and Japanese physiologists.

THE British Lords Commissioners of the Treasury have appointed Dr. J. J. Fox, deputy government chemist, to the post of government chemist, effective on April 17, on the retirement of Sir Robert Robertson, government chemist since 1921, who will be sixty-seven years old on that date.

MARSTON BATES, of the Museum of Comparative Zoology, Harvard University, has been granted leave of absence to join the entomological staff of the Rockefeller Foundation to make studies of Anopheles of Albania.

FERDINAND A. VARRELMAN, of the department of biology of the American University, is spending the year in Europe making a special study of botanical gardens for the sub-committee on botanical gardens of the Library Committee of the House of Representatives. This committee has sent out questionnaires to each botanical garden of the world making inquiries about administration, library, research, educational and other activities, with the idea that some of these ideas might be incorporated in the plans for the new Botanical Garden which the Congress hopes to develop in Washington. Professor Varrelman is making a personal survey, getting plans, photographs and other data, which may be of use to the committee. His winter headquarters are at the Botanical Institute of the Botanical Garden of the University of Vienna.

THE London *Times* reports that the party which will make the fifth attempt to climb Mount Everest in the 1935–36 expedition under the leadership of Hugh Ruttledge has been chosen by the Mount Everest Committee, of which Major-General Sir Percy Cox is chairman. The members of the party will include E. E. Shipton, leader of the Mount Everest reconnaissance party in Tibet; F. S. Smythe, whose fourth expedition to Everest this will be; P. Wyn Harris (Kenya Civil Service); Dr. C. B. Warren, formerly of St. Bartholomew's Hospital; E. G. H. Kempson, a master at Marlborough College; Major C. J. Morris, late 2nd/3rd Gurkha Rifles, and Dr. Noel Humphreys, who led the Oxford University Expedition to Ellesmere Land last year.

DR. KARL VON TERZAGHI, professor at the Institute of Technology in Vienna, will give at Harvard University, beginning on February 5, a special lecture course on recent developments in soil mechanics and its application to problems in earth and foundation engineering. These lectures will be given each Monday, Wednesday and Friday from 4 to 5 P. M., with a discussion period following each lecture.

THE fourth lecture of the series before the Harvey Society in affiliation with the New York Academy of Medicine was given on January 16 by Dr. A. B. Houssay, director of the Institute of Physiology of the University of Buenos Aires, on "The Interaction between the Parathyroid and the Hypophysis and Pancreas."

DR. JAMES BRYANT CONANT, president of Harvard University, addressed a meeting at the Academy of Natural Sciences of Philadelphia on January 16, when a program of further development of the academy was initiated by Effingham B. Morris, president of the academy. The other speaker was Dr. William Berryman Scott, emeritus professor of geology at Princeton University. Mr. Morris outlined the proposed plan for extending the activities of several departments. At the conclusion of the meeting the newest of the habitat groups in the Free Natural History Museum—a representation of East African animals gathered at a water-hole—was formally unveiled.

DESIGNED to foster investigations and disseminate information concerning the flora of the region, the Southern Appalachian Botanical Club has been formed and a journal will be published, beginning with January, 1936. Acting officers of the club are: *President,* Frank A. Gilbert, Marshall College, Huntington, W. Va.; *Vice-president,* Randolph Boggess, Duke University; *Secretary,* Paul R. Stewart, Waynesburg College; *Treasurer,* Nellie Ammons, West Virginia University; *Editor,* Earl L. Core, West Virginia University.

THE sixteenth annual meeting of the Southwestern Division of the American Association for the Advancement of Science will be held at Flagstaff, Ariz., and the Grand Canyon on April 27, 28, 29 and 30. Dr. Harold S. Colton, director of the Museum of Northern Arizona, is president, and Dr. T. J. Tormey, president of the Arizona State Teachers College at Flagstaff, is chairman of the local committee. M. R. Tillotson, superintendent of the Grand Canyon National Park, is chairman of the committee in charge of arrangements at the Canyon. Meetings for presentation of papers will be held at Flagstaff on Monday, Tuesday and Wednesday morning. On Wednesday evening the Powell lecture, with Dr. John C. Merriam as speaker, will be given at the Canyon and Thursday will be devoted to trips at the Canyon.

AN International Congress of Criminal Anthropol-

ogy and Psychiatry will be held in Rome next April, when the following subjects will be discussed: (1) aetiology, diagnosis and prophylaxis of delinquent minors; (2) prophylaxis of criminality and penal laws; (3) the fundamental principles of biology and criminal biotypology; (4) prophylaxis of crime. Visits will be paid to the more important modern penitentiaries and institutions for the prevention of criminality and the reeducation of delinquents. The general secretary of the congress is Professor B. di Tullio, via Giulia 52, Rome.

THE Laboratory Section of the American Public Health Association is anxious to collect any documentary material relating to the early history of the section, which was organized in Minneapolis in 1899. Letters, programs and biographical notes concerning members, particularly regarding the officers during the first five years of the organization, are especially desired. The section would appreciate it if any such material could be sent to the archivist, Dr. Augustus Wadsworth, director of the New York State Laboratories, New Scotland Avenue, Albany, N. Y.

DISCUSSION

DOES THE "RADIO ACT" HAMPER RESEARCH?

IN answering inquiries based on the final paragraph of my recent discussion[1] in SCIENCE, a member of the Federal Communications Commission excuses the non-cooperative activities of that body by claiming that changes must be made by Congress in the Communications Act before the commission can alter the disputed paragraphs in its own regulations. Though appreciating the friendly attitude which the commission has maintained during the discussion we contend that the commissioners are merely renewing an old army game called "passing the buck."

The needless interruption of a legitimate research enterprise is of serious consequence to all scientists. In the sincere hope that a clear discussion of the present difficulty may lead to improved governmental cooperation in the future, we wish to summarize our own view of the controversy, as follows:

(1) The commission fully admits the engineering merits of our highly-specialized radio equipment. From a technical standpoint there has been no dispute in regard to the suitability and complete safety of our method of operation. The transmitter has been thoroughly tested during many months of normal service and the operating frequency has remained stable within 0.002 per cent. The monitor device would immediately shut down the entire station if the frequency should shift by a very slight amount. Failure in other parts of the circuit might suppress the signal but could not cause faulty modulation. At all times the operation of the transmitter has been observed and automatically recorded by a monitor receiving set.

(2) We have never had any intention of dispensing with human operators and have never suggested the slightest relaxation in the strict regulations which prohibit the use of transmission apparatus by *unlicensed* persons. *Three operators,* holding commercial licenses properly issued by the government, are salaried members of our laboratory staff. They perform all services in supervising the equipment. We contend that the government is utterly unreasonable in asking us to disrupt all other research activities in order to keep any one of these men on duty at times when human intervention is clearly unnecessary and useless.

(3) Section 318, Title III, of the Communications Act of 1934 reads as follows:

> The actual operation of all transmitting apparatus in any radio station for which a station license is required by this Act shall be carried on only by a person holding an operator's license issued hereunder. No person shall operate any such apparatus in such station except under and in accordance with an operator's license issued to him by the Commission.

The context plainly indicates that this clause was inserted by Congress in order to protect the public from interference caused by the abuse of radio equipment in the hands of irresponsible or unqualified persons. We consider that the phrasing is excellent and we have no desire to modify it in any way. We also contend that our method of operation satisfies the spirit and the letter of this law to the fullest possible extent. Licensed operators completely predetermine every single dot which our apparatus emits, *whether they are actually present in the operating room when that dot leaves the antenna or not.*

(4) Our prolonged negotiations with the commission may be outlined briefly:

In June, 1934, after many months of successful, 24-hour daily operation, Secretary Herbert L. Pettey suddenly took cognizance of our semi-automatic method of operation and peremptorily ordered us to keep an operator in uninterrupted attendance, regardless of engineering necessity. Pointing out that this would involve prohibitive expense, would serve no purpose and would thoroughly disrupt our experimental program, we requested special authorization to con-

[1] H. R. Mimno, SCIENCE, November 29, 1935.

tinue normal research until the purely legalistic aspect of the matter could be examined. Though no fault had been found with the apparatus or the emitted wave, this concession was refused, and we therefore suspended all research in this field.

On November 12, 1934, after much correspondence, the whole matter was referred to a member of the legal staff of the commission, *who stated emphatically that our interpretation of the Radio Act was completely correct in every respect.*

On the basis of this opinion, the engineers of the commission requested me to prepare suggestions for a new clause in the regulations designed to recognize the special requirements of ionosphere observatories. In view of the long interruption which had already occurred, the engineers agreed to proceed as rapidly as possible and estimated that we could resume normal operation within three weeks. Our suggestions were prepared immediately.

On February 9, 1935, the proposed amendment was still "under consideration."

On April 27, we discovered for the first time that Counsel Spearman and Commissioner Stewart had overruled the previous legal opinion. Their opposition was frankly largely based upon apprehension lest the use of semi-automatic apparatus in research involve the commission in disputes over the use of unattended equipment in commercial communication. Mr. Stewart therefore requested specific suggestions which would enable the commission to discriminate between the two cases. We immediately prepared a detailed statement pointing out that we are not engaged in any form of communication, and that our transmission is completely determined at all times by our licensed operators. On the other hand, the commercial stations are clearly engaged in some form of point-to-point or broadcast communication. Uninterrupted supervision by licensed operators could logically be demanded in order to prevent the use of profane and obscene language, even if the commercial stations could match the highly specialized protective equipment necessitated by our research problems. We have received an acknowledgement of our letter, but no reply to our detailed suggestions as yet.

In any case, this aspect of the matter clearly involves a question of administrative expediency and not fundamental law. We must therefore conclude that the present attitude of the commission is based on an instinctive desire to preserve the *status quo* at any cost and that this desire hampers scientific research unreasonably.

HARRY ROWE MIMNO

CRUFT LABORATORY,
HARVARD UNIVERSITY

COFFEE AND CACAO IN SOUTHERN FLORIDA

RECENT experiments have shown that conditions for normal growth and fruiting of coffee and cacao can be provided in southern Florida, not in open field plantings but sheltered by larger trees, as in gardens, courts or dooryards. Even with no indication of commercial production being feasible, many residents and winter visitors in Florida are attracted to the more tropical crops, not grown elsewhere in the United States, and often have time and money to use in local experiments. The amateur plantsmen are recruited from many lines of experience in other regions as farmers, horticulturists and botanists, teachers, merchants, manufacturers, chemists, technologists and inventors, so that attention may be given not only to the culture and breeding of coffee and cacao, but also to processes of fermentation and curing, which may largely determine flavors and commercial values. Miami is becoming an educational center with special facilities for tropical plant research and training of tropical experts.

Coffee is a handsome spreading shrub or small tree, with shining laurel-like leaves, fragrant white flowers and clusters of crimson berries, while the "chocolate-tree" is remarkable for its habit of cauliflory, bearing its small star-like flowers and large gourd-like fruits along the naked trunk and larger limbs, not on the new growth with the leaves. Both trees are outstanding examples of dimorphic branching, but are specialized on different lines that serve well for comparative study as an introduction to this strangely neglected field of botanical science. The vegetative adaptations of plants eventually may be recognized as not less significant than the floral adaptations that have had so much attention.

Shade-trees and cover-crops are used with coffee and cacao in most of the tropical countries, and are especially needed in Florida. Thin soils and strong trade-winds rapidly intensify drought conditions, so that emergency watering is necessary, though less is required in protected cultures. As a soil cover, the Sarawak bean, *Phaseolus hosei,* a small-leaved creeping plant from the Malay region, was recommended by the late Edward Simmonds, and has proved entirely satisfactory. The conditions of wind and soil protection that were found necessary for raising Hevea rubber trees at the Plant Introduction Garden a few miles below Coconut Grove, Florida, as stated in SCIENCE of May 3, 1935, also have produced the most normal and fruitful young trees of coffee and cacao, some of them flowering and fruiting in the second season.

Winds are more moderate away from the coast, but exposure to drought and frost may be greater, since much of the interior country is denuded and fire-swept. Efforts to drain the Everglades undoubtedly have increased the fires and the local frost hazards in recent years, though the danger of further denudation is being recognized, and facilities of irrigation and fire control may be established to protect and develop the tropical region.

Many of the tropical crop plants have the ecological status of hylophytes, that is, they are specially adapted to forest undergrowth conditions where the sun and wind do not reach the soil surface, which explains why so many tropical seeds, like coffee and cacao, are viable only in the fresh state and do not withstand drying. Also the hylophytes may be considered as shade-tolerant plants, contrasting with *agrophytes* as plants of open country, requiring full exposure to the sunlight. For the forest undergrowth vegetation the protected cultures undoubtedly provide more normal conditions than the open cultures that are customary in temperate climates, as well as affording more shelter from frost.

Cacao is more delicate than coffee and more likely to suffer from local frosts, though in some respects easier to grow, the seeds germinating in a few days while coffee takes several weeks. Plantings in different districts are desirable, so that local supplies of seed may be at hand to facilitate tests and replacements. Cacao, like the Hevea rubber tree, tolerates wet lands and periods of flooding. Farmers who begin by raising a few trees and find pleasure in preparing their own product and supplying their own households have the best prospects of utilizing new crops. New methods and systems of tropical farming may be worked out in Florida, very different from the contract-labor plantations of the East Indies and with greater promise of human satisfactions.

Coffee competes with rubber as our most valuable agricultural import, though having only a beverage use, while chocolate is a rich food. Extensive cultures of coffee and cacao in several tropical countries have been destroyed by pests and diseases, and continued absence of these in Florida may stimulate interest in local experiments. A fungous disorder of cacao in Ecuador, Venezuela and Guiana is responsible for the recent shifting of the centers of production to Brazil and West Africa, thus repeating the history of previous transfers, first from southern Mexico and Guatemala to Nicaragua, Costa Rica and the West Indies, and later to the South American countries.

O. F. COOK

BUREAU OF PLANT INDUSTRY
SEPTEMBER 17, 1935

THE SIMILARITY BETWEEN THE MECHANISM OF THE RENNIN AND PECTASE (PECTIN-METHOXYLASE) REACTIONS

ATTENTION has been called recently in these pages[1] to the fact established by Hammersten[2] in 1875 that the coagulation of milk by rennin occurs in two distinct reactions, *viz.*, enzyme action and the subsequent formation of the coagulum. It is our purpose to note the striking similarity between the mechanism of this reaction and the gel formation from pectin by pectase. In both cases the enzyme causes a slight degradation of the molecule, which also is the first step in the enzymic decomposition of the substrates. In the absence of calcium (Sr, Ba, etc.) no visual evidence of the enzyme action occurs. In the presence of or upon the addition of calcium, however, the para-casein in milk and pectic acid produced from pectin both form insoluble salts; and a coagulum or gel appears.

One of us recently made a detailed separate study[3] of the two reactions involved in the gel formation by pectase, *i.e.*, the enzymic de-methoxylation and the formation of the gel. The two reactions have different pH optima, that of the gel formation depending greatly on the experimental conditions.

The changes in the relative velocity of the two reactions cause the appearance of the pH optimum for the diphasic visible change at a varying pH value. It will be of great interest to see whether similar conditions exist in the case of the rennin reaction.

A. C. DAHLBERG
Z. I. KERTESZ

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA

IODINE IN GOITER TREATMENT

DR. MCCAY, in his interesting article[1] on the work of Boussingault, closes with the proposition, "One can only speculate concerning the human suffering that might have been evaded if some eminent physician had noted this contribution of the French chemist at an early date."

The following quotation from a treatise a century old serves to quiet any speculation on this question.

It may not be amiss to observe here that the author of the present volume first employed the hydriodate of potash, as a remedy for goitre, in the year 1816, after having previously ascertained, by experiments upon himself, that it was not poisonous in small doses as had been represented. Some time before the period stated, this

[1] A. G. Smith and H. C. Bradley, SCIENCE, 82: 467, 1935.
[2] See a review of this problem in "Fundamentals of Dairy Science," A. C. S., Monograph series, 1935.
[3] Z. I. Kertesz, in "Ergebnisse der Enzymforschung," Vol. 5, in press.
[1] SCIENCE, 82: 350, 1935.

substance had been found in certain marine productions; and it struck the author that burnt sponge (a well-known remedy for goitre) might owe its properties to the presence of Iodine, and this was his motive for making the trial. He lost sight of the case in which the remedy was employed, before any visible alteration was made in the state of disease; but not before some of the most striking effects of the remedy were observed. The above employment of the compounds of Iodine in medicine was at the time made no secret; and so early as 1819, the remedy was adopted in St. Thomas's Hospital, by Dr. Elliotson, at the author's suggestion.

The above quotation is taken from "Chemistry, Meteorology and the Function of Digestion," by William Prout, M.D., F.R.S. The book ran through three editions, the first of which appeared in 1834. Prout himself is best known for his intriguing hypothesis about the constitution of matter, but devoted most of his energy to medical practice and made several important contributions to the use of chemistry in medicine. John Elliotson, F.R.S., referred to in the above quotation, was "without doubt foremost among the eminent physicians of the day."[2]

Thus, the use of iodine in the treatment of goiter was known to at least two "eminent physicians." The speculations now in order are legion.

R. K. SUMMERBELL
FRED D. AYRES
NORTHWESTERN UNIVERSITY

GENETICS, SULFHYDRYL AND CANCER

THE discovery that the –SH group is a naturally occurring chemical stimulus to cell increase in number[1] produced the suggestion that ". . . the potentiality for malignancy lies in the hereditary determination of lines of cells retaining the embryonic characteristic of a heightened sensitivity to . . . sulfhydryl. . . ."[2]

A critical point in this idea—which was not advanced as dogma but as a base from which exploration could be made—was the unproved concept that deviations in reactivity to or production of such an ubiquitous and environmentally sensitive chemical group as the sulfhydryl should be subject to or even determined by genetic factors.

Recently evidence has come from other laboratories than ours that genetic constitution does play a part in sulfhydryl matters. Thus Gregory and Goss[3] find positive correlation between potential racial size (which Painter[4] has shown to be correlated with rate of cell division) and glutathione (–SH) concentration in newborn Flemish and Polish rabbits and their hybrids. From their results they state "the data at hand indicate that a genetic constitution for a given adult size maintains a certain glutathione level which in turn regulates the rate of cell proliferation and growth by increase in cell number."

More recently Martin and Gardner[5] report results which indicate liberation of cysteine (–SH) from glutathione is also conditioned by genetic factors. Thus in the hairless rat neither cystine nor glutathione (R–S. S–R) as such produce reaction, while "Cysteine through the sulfhydryl group acts as a stimulant to the hair follicle, bringing about a trichogenic action in hereditary hypotrichosis of the rat."

Though in geometry "two things which are equal to the same thing are equal to each other," the same does not necessarily hold in biology. The mere fact that heredity plays a part in cancer potentiality, that cell proliferation is a large factor in malignant growth, that cell proliferation is enhanced by sulfhydryl, and that this may be genetically determined, may or may not mean anything with respect to the suggestion that inherited disturbance in productivity of or sensitivity of sulfhydryl may be a significant factor in malignancy.

Perhaps these correlations are not functional—but their appearance is provocative.

FREDERICK S. HAMMETT
RESEARCH INSTITUTE OF THE
LANKENAU HOSPITAL, PHILADELPHIA

SCIENTIFIC BOOKS

ATOMIC SPECTRA

The Theory of Atomic Spectra. By E. U. CONDON and G. H. SHORTLEY. Cambridge University Press, pp. 431, 1935.

A VERY useful summary of most of the calculations available at present on the theory of spectra. The subject is clearly and logically presented. The mathematical tools used are as elementary as possible and the book should be therefore readily assimilated by a large circle of readers. Its main strength lies in a complete and careful compendium of most of the available results of calculations of energy matrices in various types of coupling. These are presented in Chapter XI for intermediate coupling, while in Chapter XII the transformations to various cases of pure coupling are thoroughly discussed. Chapter XIII is especially devoted to configurations containing almost closed shells and discusses the subject very thoroughly.

[2] Dictionary of National Biography, Vol. XVII, p. 265.
[1] *Protoplasma*, 7: 297, 1929.
[2] *Archives Pathol.*, 8: 575, 1929.
[3] *Jour. Exp. Zool.*, 66: 155, 1933.
[4] *Jour. Exp. Zool.*, 50: 441, 1928.
[5] *Jour. Biol. Chem.*, 111: 193, 1935.

The computational side of the theory is nicely tidied up. Any one working in the subject knows that it is very time-consuming to apply the results available in the literature on account of the large variety of notations and conventions used about signs of wave functions, normalizing factors and other similar details. It is in fact often found that a paper dealing with energies in Russell Saunders coupling may be completely useless in applications to cases of intermediate coupling, because the author may find it expedient to avoid using wave functions altogether. It is very usual that in a new application of the theory one has to rework all previous applications from the beginning, so that, for example, calculations performed by Mr. Johnson on the energies of a configuration in intermediate coupling can be used by Mr. Wills only as a check when he wishes to work out formulas for the hyperfine structure of the same configuration. It is very gratifying that Condon and Shortley have systematized the subject by standardizing conventions as to signs and normalizing factors. By so doing they make the existing literature readily available for future applications and extensions.

The tidying up process is facilitated by a rational treatment of spherical harmonics which was supplied to the authors by H. P. Robertson and is given towards the beginning of the book. This choice of spherical harmonics which is used corresponds to those simple forms of angular momentum matrices which were introduced with the beginning of matrix mechanics. These are more practical than the cumbersome sign conventions inherited from old-fashioned mathematics. In the symbolic method used with success by Weyl, Wigner, Kramers, Brinkman, they correspond to $\binom{2l}{l+m}\ \xi^{l+m}\ \eta^{l-m}$. If the book were not confined to the use of elementary methods one could further understand the summation theorem as follows. Let $Y_l^m(\mathrm{I})$, $Y_l^m(\mathrm{II})$ be the above-mentioned spherical harmonics of two directions I and II normalized so as to have $\int [Y_l^m]^2 d\Omega = 1$ where Ω is the solid angle. Then one sees with little trouble that $\Sigma Y_l^{m*}(\mathrm{I})\ Y_l^m(\mathrm{II})$ is a rotational invariant and therefore depends only on the angle θ between the directions I and II. Since the sum satisfies Laplace's equation it is a multiple of the Legendre function $P_l(\cos\theta)$. Remembering that $Y_l^0 = [(2l+1)/4\pi]^{1/2} P_l$ and making I = II, it follows that the above sum is $(2l+1)P_l/4\pi$.

The discussion of the composition of angular momenta (p. 57) is presented clearly from an elementary point of view. It appears to presuppose the existence of wave functions corresponding to the composed angular momenta. The existence of such functions can be elucidated by observing that an operation with $J_x - iJ_y$ on the function in the $j_1 + j_2$ column gives a linear combination of the two functions in the $m_1 + m_2 - 1$ column and that therefore one of the two solutions of the secular determinant for J^2 formed on the functions of the $m_1 + m_2 - 1$ column belongs to $J^2 = j(j+1)$. Similarly, one sees that at least one of the functions in all columns belongs to this same value of J^2. In a similar way one proceeds with the other values of J^2 by orthogonalization.

On p. 60 we find Dirac's tricky way of proving the selection rule $\Delta j = \pm 1, 0$. In spite of the ingenuity of this method it seems also advisable to look at the matter from a different point of view which simultaneously presents the intensity sum rule in the Zeeman effect without detailed calculation. Referring to the magnetic quantum numbers of the upper level by μ and to those of the lower level by m, one shows that $\Sigma_m \{ |x_{\mu m}|^2 + |y_{\mu m}|^2 + |z_{\mu m}|^2 \}$ is independent of μ by noticing that this sum is a special case of the sum $\Sigma_m \{ x_{\mu m} x_{m\mu'} + y_{\mu m} y_{m\mu'} + z_{\mu m} z_{m\mu'} \} = Q_{\mu\mu'}$. This sum commutes with the three components of the angular momentum J and is therefore a constant times the unit matrix. This view is a natural one because it makes direct use of the rotational invariance of the transition probability. Similarly, $\Sigma_\mu \{ x_{m\mu} x_{\mu m'} + \cdots \} = P_{mm'}$ is a multiple of the unit matrix. The selection rules for m now show that if $|\Delta j| > 1$ there is always a magnetic level of the level with the greater j for which either Q or P is zero and that therefore if $|\Delta j| > 1$, P and Q are zero for all magnetic sublevels. The additional exclusion of $j = 0$ jumping into $j = 0$ follows from spectroscopic stability for polarization, which in turn is a consequence of the invariance of a spur under unitary transformations. Although these methods of presentation are closely related to discussions by means of group theory, they are sufficiently elementary to be universally digestible and appear to be more directly related to the physics involved than the algebraic procedures introduced in the early literature and frequently reproduced in books.

It is particularly nice to see frequent comparisons of theory and experiment throughout the book. Most of this is available in the literature, but the combined effect of the graphical comparison between theory and experiment is very convincing as to the essential correctness of the usual form of theory.

The computer of theoretical spectroscopic relations will be delighted to find on pp. 76–77 tables of transformation coefficients for vector coupling between an arbitrary angular momentum j_1 and angular momentum $j_2 = \frac{1}{2}, 1, \frac{3}{2}, 2$. The section on the theory of radiation also adds materially to the value of the book, although it does not pretend to be an exhaustive or learned account. It is regrettable that the spin orbit interaction in many-electron spectra is introduced pretty much by analogy with one-electron spectra without the theoretical justification which is available.

In the study of the section on hyperfine structure, the reader may be helped by the following remarks. For single-electron spectra all the formulas given can be summarized by $\Delta w = \frac{a}{2}[f(f+1) - i(i+1) - j(j+1)]$; $a = \frac{2g\mu_0^2 l(l+1)}{1840\, j\,(j+1)} \cdot \overline{\left(\frac{1}{r^3}\right)}$ where for $l = 0$ one should use the limiting value $l(l+1)\overline{r^{-3}} = 2\pi\psi^2(0)$ and the nuclear g factor is expressed in terms of the theoretical magnetic moment of the proton. The energy expression for the lowest ^3S term of Li which is given by

$$1.06\frac{8\pi}{3}\mu_0 M\psi^2(0)\left(-\frac{5}{3}, -\frac{2}{3}, 1\right)$$

as Equ. (1) on p. 425 takes into account the influence both of the 1s and the 2s electrons. The correction for the 2s electron is represented by the factor 1.06 and has been computed by two independent methods, one of which consists in a variational calculation of the cartesian coordinate wave function. The present status of calculations on hyperfine structure in intermediate coupling is that deviations from theory are of the correct order of magnitude to be explicable as due to the same cause as the deviations of properties of gross structure from theory. This conclusion has been arrived at by comparing expressions for wave functions derived from different properties of the gross structure such as intervals and the Landé g factors for the Zeeman effect. This study therefore indicates that the interaction between configurations is related to the deviations of hyperfine structure from the theoretical relations which correspond to simple configuration assignments.

The book contains many neat and useful points which add to its value as a general reference volume. Thus on page 127 one finds a neat explicit representation of functions for Dirac's equation in a central field leading to the two radial equations which are so useful in applications. Here also one finds Darwin's reduction of the Dirac equation to the Pauli spin form, but one should be cautioned against applying this form to hyperfine structure. Similarly, one finds reference to the use of Dirac's vector model made by Van Vleck and a detailed summary of self-consistent field calculations.

G. BREIT

SPECIAL ARTICLES

GROWTH IN HEIGHT AND WEIGHT IN COLLEGE AND UNIVERSITY WOMEN

MEAN height and weight measurements of college and university women, when obtained from independent samples of the population at successive ages, have revealed no consistent changes associated with advancing age.[1] Consecutive annual measurements made upon the same individuals do not confirm this result.[2] They indicate that there is a small but significant increase in these measures of physique throughout the four college years. These contradictory findings prompted the present investigation in which the same data are subjected to the two different types of analysis. The data were made available to us by the Department of Physical Education for Women at Stanford University.

Height and weight measurements were assembled from 1,290 individuals. Of these 1,134 were remeasured after one year, and 446 after two years. In assigning the measurements to specific ages, a certain degree of arbitrariness could not be avoided because the time at which measurements were made varied widely with respect to the subjects' birthdays. We assigned to a given age-group any measurement that was made within an interval of six months preceding and six months following the birth date. The majority of remeasurements followed first measurements with an interval closely approximating one or two years. The means of the intervals are 11.5 and 23 months, respectively.

When these data are analyzed by computing the mean measurements for independent samples at the successive ages, we obtain the results presented in Table 1. If two or more annual measures were avail-

[1] Fritz Bach, *Zeits. f. Konstit. lehre*, 16: 28–62, 1931; H. S. Diehl, *Human Biology*, 5: 600–628, 1933; H. N. Gould, *Research Quart. of the Amer. Physical Ed. Assn.*, 1: 1–18, 1930; C. M. Jackson, *Am. Jour. Physical Anthrop.*, 12: 363–413, 1928.

[2] B. F. Baldwin, *Univ. Iowa Studies: Stud. Child Welfare*, 1: pp. 411, 1921; H. N. Gould, *ibid.*

TABLE 1

HEIGHT AND WEIGHT DATA FOR WOMEN STUDENTS AT STANFORD UNIVERSITY. (INDEPENDENT SAMPLES AT EACH AGE; NO REMEASUREMENTS)

Age	N	Height (inches)			Weight (pounds)		
		Mean	S.D. mean	S.D. dist.	Mean	S.D. mean	S.D. dist.
17	331	64.75	.09	1.69	124.85	.85	15.72
18	553	64.71	.09	2.19	123.05	.65	15.31
19	263	64.72	.14	2.26	123.24	.98	15.84
20	94	64.63	.23	2.28	120.90	1.41	13.70
21	49	64.54	.34	2.37	125.56	2.80	19.58

TABLE 2
MEAN INCREMENTS IN HEIGHT, BASED UPON CONSECUTIVE MEASUREMENTS OF THE SAME INDIVIDUALS

Measured at	N	Height at younger age		Height at older age		r.*	Increment	Incre.
		Mean	S.D.	Mean	S.D.			S.D. incre.
17 and 18 ..	224	64.603	1.418	64.763	2.175	.979	.160	2.8
18 " 19 ..	435	64.698	2.125	64.853	2.203	.968	.155	5.9
19 " 20 ..	339	64.807	2.288	64.898	2.311	.982	.091	3.8
20 " 21 ..	136	64.426	2.338	64.441	2.294	.984	.015	0.4
17 " 19 ..	132	64.462	1.612	64.750	2.184	.965	.288	4.4
18 " 20 ..	214	64.621	2.135	64.790	2.191	.953	.169	3.7
19 " 21 ..	100	64.620	2.261	64.740	2.410	.972	.120	2.1

* Product-moment correlations between the measures at the younger and at the older ages.

able for a given subject, we used only the first of these in the present calculations. It will be noted that there is no consistent change in mean height or weight from age to age and that none of the differences are statistically significant. The mean weight at 20 years is somewhat lower than would have been expected from the trend of the preceding and following means. We have no way of determining the cause of this fluctuation. It is clear that this analysis gives no indication of growth in this group of university women between the ages of 17 and 21.

When these data are analyzed by computing the mean heights and weights of the same subjects on successive years we obtain the results presented in Tables 2 and 3. Table 2 gives the statistical constants for the height distributions at the ages of first measurement and at the ages of remeasurement. It may be seen that there is a small but significant mean annual and biennial increment in height for consecutive ages from 17 to 20 years. An estimate of the total increment from 17 to 21 years is .4 inch. As shown by the data of Table 3, there are also significant annual increments in weight between the seventeenth and nineteenth years, and significant biennial increments between the ages of 17 and 20 years. For the four-year period, the estimated mean increment is 5.75 pounds. This analysis gives unmistakable evidence of growth in this group of university women between the ages of 17 and 21 years.

The results of the two methods of studying height and weight data confirm the results of previous investigations which have come to our attention. When independent samples of the female college population at successive ages are used, no evidence of growth is found; when the same subjects are measured at successive ages, clear evidence of growth appears. It is apparent that there is no discrepancy as to fact, the discrepancy arises from the method used and the conclusions drawn therefrom. There can be no doubt that the method involving remeasurements of the same individuals offers the best control and that the conclusion that growth continues during the college years is justified.

The reason that studies based upon independent samples at different ages fail to reveal growth probably is the differential selection with respect to the physique of college women of different ages. The younger college women represent a group that is precocious physically as well as mentally. Although the correlation between mental and physical precocity is known to be low,[3] the younger college entrants may also be selected for economic advantage and good health, both of which are positively correlated with superior physique.

In presenting this note[4] the authors hope not only to point out the methodological basis of an apparent discrepancy in the results of different investigators, but also to stimulate others to search in the archives

[3] D. G. Paterson, "Physique and Intellect," New York: Century. Pp. xxvii + 304. 1930.

[4] These data were assembled in connection with a more comprehensive study on the relationship between physique and menarcheal age in university women, soon to appear in the journal *Human Biology*.

TABLE 3
MEAN INCREMENTS IN HEIGHT, BASED UPON CONSECUTIVE MEASUREMENTS OF THE SAME INDIVIDUALS

Measured at	N	Weight at younger age		Weight at older age		r.*	Increment	Incre.
		Mean	S.D.	Mean	S.D.			S.D. incre.
17 and 18 ..	224	124.175	15.671	126.605	15.823	.919	2.430	5.8
18 " 19 ..	436	124.060	15.892	126.065	16.031	.923	2.005	6.6
19 " 20 ..	339	124.300	15.798	124.800	15.802	.929	0.500	1.5
20 " 21 ..	135	121.020	13.001	121.835	13.979	.915	0.815	1.7
17 " 19 ..	132	123.370	16.173	126.170	16.868	.893	2.800	4.2
18 " 20 ..	210	121.855	15.359	124.355	15.522	.910	2.500	5.5
19 " 21 ..	100	121.700	13.282	122.800	14.283	.913	1.100	1.9

* Product-moment correlations between the measures at the younger and at the older ages.

of physical education departments for publishable consecutive measurements of physique, and to encourage departments which do not repeat the measurements to do so in order that a sizable mass of consecutive measurements may be assembled. Probably the best sources of data by means of which the terminal phases of physical development may be studied at the present time are the college and university populations.

ROGER G. BARKER
CALVIN P. STONE

DEPARTMENT OF PSYCHOLOGY
STANFORD UNIVERSITY

KETENE ($CH_2=CO$): A NEW REAGENT FOR THE DETOXIFICATION OF VACCINE[1]

KETENE reacts with water, alcohols, primary and secondary amines and acids to form acetylated compounds, according to the investigations of Staudinger.[2] The rate of reaction of ketene for each of the above groups is different—primary amines react most rapidly. In general, the reactions of ketene are addition reactions and may be illustrated as follows:

$$CH_2=CO + H\text{–}NH\text{–}R \longrightarrow CH_3CONH\text{–}R.$$

Bergmann and Stern[3] have shown that ketene reacts with amino-acids to form acetylated amino-acids. Recently Herriott and Northrop[4] used ketene for acetylating the amino groups of pepsin. In our work *B. dysenterae* Shiga were treated with ketene.

Ketene was produced by the thermal decomposition of acetone vapors in a generator similar in design to Herriott's.[5] The gas was passed through a long water condenser and then through a spiral coil, which was cooled to 0° C. to condense any acetone vapors and polymers of ketene. After leaving the ice trap the ketene was passed through a 4 mm tube into a collodion dialyzing sack containing a twenty-hour culture of *B. dysenterae* Shiga suspended in 10 cc of saline solution and 190 cc of 2 M sodium acetate solution. The sack was immersed in a vessel containing 2 M sodium acetate solution in order to keep the pH nearly constant (a procedure adopted by Herriott and Northrop for maintaining a constant pH). Ketene was run into the bacterial suspension at the rate of one bubble per second for one half hour. A mechanical stirring device kept the suspension agitated.

One half hour exposure of the bacterial suspension to ketene was sufficient to kill the organisms. Such a treated suspension was washed with sterile distilled water once and with sterile saline solution three times before the desired density of the suspension was made. A control vaccine was prepared by heating a suspension of the bacilli at a temperature of 60° C. for 45 minutes.

Rabbits were inoculated intravenously at seven-day intervals with ketene-treated vaccine. The lethal dose of either heat-killed suspension or living bacilli suspension was given intravenously from one week to eleven days after the last injection of vaccine. All vaccines were of a density of 300 according to the Fuller's scale.

The results of intravenous inoculation into rabbits all weighing over 2,000 grams are shown in Table I.

TABLE I

Rabbit	Number of inoculations	Total cc of vaccine given	Days between first inoculation and lethal dose	Lethal dose cc	Results
Immunized with ketene treated vaccine					
1	3	2	33	0.5 H	No toxic effects
2	3	2	33	0.5 H	" " "
3	3	2	27	0.5 H	" " "
4	3	2	27	0.5 H	" " "
5	4	2	28	0.5 H	" " "
6	4	2	28	0.5 H	" " "
7	4	2	28	0.5 H	" " "
8	4	2	28	0.5 L	" " "
9	4	2	28	0.5 L	" " "
10	4	2	28	0.5 L	" " "
Non-immunized controls					
11	1	0	0	0.4 H	Complete paralysis. Died—36 hrs.
12	1	0	0	0.5 H	Complete paralysis. Died—40 hrs.
13	1	0	0	0.5 H	Complete paralysis. Died—34 hrs.
14	1	0	0	0.5 H	Complete paralysis. Died—36 hrs.
15	1	0	0	0.5 H	Complete paralysis in 60 hrs.*
16	1	0	0	0.5 H	Complete paralysis in 72 hrs.*
17	1	0	0	0.5 H	Paralysis in 52 hrs.*
18	1	0	0	0.5 L	Complete paralysis in 32 hrs.*

L—Living bacilli suspension.
H—Heat-killed vaccine.
*—Animal chloroformed.

Ten rabbits, each previously receiving a series of injections of ketene-treated vaccine over a period of 27 to 33 days, totaling 2 cc, manifested no toxic effects upon receiving the lethal dose of 0.5 cc of either heat-killed or living *B. dysenterae* Shiga. Eight control rabbits which had not received the ketene-treated vaccine showed complete paralysis with usual diarrhea and died within four days after each had been injected with 0.5 cc of either heat-killed or living *B. dysenterae* Shiga.

CONCLUSION

Acetylation of *B. dysenterae* Shiga with ketene for one half hour detoxifies the antigen. Such an antigen can be inoculated in large doses into rabbits without

[1] Preliminary report.
[2] H. Staudinger, "Die Ketene," Stuttgart, F. Enke, 1912.
[3] M. Bergmann and F. Stern, *Ber. Chem. Ges.*, 63: 437, 1930.
[4] R. M. Herriott and J. H. Northrop, *Jour. Gen. Physiol.*, 18: 35, 1934.
[5] R. M. Herriott, *Jour. Gen. Physiol.*, 18: 69, 1934.

producing toxic effects. Animals immunized with ketene-treated vaccine are highly resistant to doses of living or heat-killed bacilli which are lethal for non-immunized animals.

JOSEPH T. TAMURA
DEPARTMENT OF BACTERIOLOGY
M. J. BOYD
DEPARTMENT OF BIOCHEMISTRY
COLLEGE OF MEDICINE
UNIVERSITY OF CINCINNATI

THE OROGENIC HISTORY OF CENTRAL UTAH[1]

DURING the course of studies in 1929–1933 by the writer in the Wasatch Plateau, of central Utah, evidence accumulated to suggest that the rocks there classified as the lower part of the Wasatch formation were not really Wasatch (lower Eocene) in age, but older, perhaps still older Eocene. In the summer of 1934 the writer, searching for fossil evidence on the age of these beds, gathered a small collection of bone fragments which, although not exactly identifiable, were pronounced by C. W. Gilmore to be unmistakably dinosaurian. The presence of these fossils suggested a Cretaceous age for the beds containing them. In June, 1935, J. B. Reeside, Jr., and the writer made a somewhat more extended search, which resulted in a much larger volume of better material, from widely scattered localities. This material remains to be studied by Mr. Gilmore, and the limits of its significance can not yet be stated, but it serves clearly to verify the presence of a varied reptilian fauna, including dominantly several types of dinosaurs, at the time when the beds hitherto classified as the lower member of the Wasatch formation in central Utah[2] were deposited. Inasmuch as these strata were laid down considerably later than the major orogenic disturbance in which the rocks of the Wasatch Mountains were folded, the discovery in them of dinosaurian remains necessitates a notable revision of existing concept respecting the place in the geologic time scale of the known physical events, and this note is offered for the purpose of placing the essential facts on record pending the preparation of a fuller account, in which details of revision can be set forth.

In brief, the rocks of central Utah reveal the following sequence of events in late Cretaceous time:

(1) At some time following the deposition of the Price River formation[3] (coarse sandstones and conglomerates of upper Montana age) the rocks of the region were intensely folded and thrust as far east as the western border of the present Wasatch Plateau; this was the major folding of the mass now forming the Wasatch Mountains.

(2) After an epoch of profound and probably rapid erosion, a varied assortment of sediments, ranging from boulder conglomerate through sandstone to red shale and white to gray freshwater limestone, was deposited, attaining a maximum thickness of several thousand feet.

(3) The region was again disturbed, this time more gently, and the rocks of (2) were tilted up and planed off.

(4) Sedimentation again ensued, beginning with coarse boulder conglomerate and passing on to sandstone, shale and local limestone, including some varicolored sediments but in general not the deep reds of the foregoing strata; these are the dinosaur-bearing beds, formerly classified as the lower member of the Wasatch formation.

Other later epochs of disturbance are recognized in the region, but in confinement of this note to the essential facts concerning the older folding they need not be specifically mentioned.

The dinosaur bones are sparse at all known localities except the one discovered in 1934, and in general they are difficult to find; they occur as scattered individual bones and parts of skeletons, many broken before burial. In answer to the question whether they were possibly reworked from older beds it should be pointed out that the fragility of many of the specimens, the presence of large bones in very fine-grained sediments, the wide distribution of the remains in general and the abundance of the material at the best locality, which is many miles from the nearest possible source in older rocks, effectively demonstrate that the fossils are indigenous to the strata in which they are found.

The first disturbance above mentioned, the major compressive movement in the Wasatch Mountain belt, has generally been considered to mark the close of Cretaceous time, and the succeeding sediments have generally been classified as Eocene, although fossil evidence has been meager and difficult to interpret, in notable part suggestive of age older than Eocene but decidedly not conclusive, and in terms of pre-existing classification acceptable as Eocene. In all the rest of the known Rocky Mountain-Great Plains province the latest dinosaurs are found in the Lance and equivalent beds, now classified by many geologists as Cretaceous. There are of course involved here all the ramifications of the celebrated Laramie problem, and geologists familiar with the controversial terms

[1] Published by permission of the director of the U. S. Geological Survey.

[2] Edmund M. Spieker and John B. Reeside, Jr., *Geol. Soc. Am. Bull.*, 36: 448–449, 1925; Edmund M. Spieker, *U. S. Geol. Survey Bull.*, 819: 45–48, 1931.

[3] Spieker and Reeside, *op. cit.*, pp. 445–448; Spieker, *op. cit.*, pp. 39–45; Edmund M. Spieker and John B. Reeside, Jr., *Geol. Soc. Am. Bull.*, 37: 431–433, 1926.

of this issue will see at once a number of possible dispositions of the evidence here announced, but such matters can not be dealt with in this brief note. It should be noted, however, that this discovery puts on record the first area, to the writer's knowledge, in which the relation of the orogenic movements to the dinosaur-bearing strata is unmistakably clear and not subject to the debatable elements of interpretation. Whether the end of the Cretaceous is to be set at the major orogenic disturbance or at the disappearance of the dinosaurs need not be considered here. The relative significance in terms of the physical record of the names Cretaceous and Tertiary is of lesser importance just now than the recognition that the dinosaurs were present some time after the early and more profound folding in this part of the Cordillera and that the beds containing the dinosaurian remains can hardly, by any stretch of imagination, be considered later than the Lance beds of the plains. Final analysis will probably justify the classification of the strata as Cretaceous.

The regional implications of this discovery can not yet be stated with any certainty, but the profundity of the folding and thrusting in the Wasatch Mountains, considered along with the known structural relations to the north, in Idaho, Wyoming and Montana, almost excludes the possibility that the disturbance was merely local, and suggests strongly that we are dealing here with the major orogenic movement in this general belt of the Cordillera.

EDMUND M. SPIEKER

OHIO STATE UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PETROLEUM SPRAYS FOR DANDELIONS

THE very general interest shown in a paper read by the authors at the Pittsburgh meetings leads us to publish this preliminary note on our experiments in the control of dandelions with petroleum sprays. Certain of the higher boiling hydrocarbons contained in the groups sold commercially as distillates and kerosene show a remarkably differential action when sprayed on bluegrass (*Poa pratensis*) lawns at the rate of 200 or 300 gallons an acre. Under favorable conditions the dandelions (*Taraxacum officinale*) are slowly but completely killed, while the bluegrass sod is only temporarily affected. In our experiments, sprays applied on September 20, 1933, in rather warm weather, resulted in a 70 per cent. control of dandelions. Sprays applied on June 6, 1934, in the evening of a hot day, resulted in 63 per cent. control. Sprays applied on a hot day in July of the same year were not carefully checked but gave no noticeable control. Sprays applied on October 1, 1934, in frosty weather resulted in controls of 99 to 100 per cent. Sprays applied on May 20, 1935, in distinctly cool weather (60° F.), have given a control of 95 per cent. or better. It is not clear at the present time whether the stage of development of the dandelion plant at the time of applying the spray is the important factor or whether temperature with its effect upon vaporization of the applied material is the more important. We are inclined to think that temperature is at least a major factor, and would recommend spraying only in cool weather. Petroleum sprays will readily adhere to and penetrate the foliage, either wet or dry, of both dandelions and lawn plants so that a period of cool rainy weather in the spring or fall would appear to be a favorable time for applications. Our results to date would favor fall applications, largely because fewer dandelion seedlings develop before the stolons of the bluegrass have spread to fill in the open areas.

The material may be sprayed broadcast over the lawn at the rate of one half gallon per 100 square feet or, where the dandelion plants are more scattered, a spotting method of spraying may be used. Applications in excess of 300 gallons an acre or about three quarts per 100 square feet may injure the grass, and the use of impure distillates showing a yellow coloration has resulted in a complete kill of bluegrass and white clover sod so that only the water-white products should be used, and even among these some appear to be more toxic to bluegrass and less differential in their action than others. This toxicity is reduced by washing the distillates with H_2SO_4 to remove unsaturated hydrocarbons.

The distillate sprays penetrate the leaves of the dandelion and other plants almost instantly and appear to be slowly moved downward through the roots. Injurious effects other than a cessation of growth may not appear for a week or 10 days, and frequently dandelion plants will continue to die for a month after the spray is applied. Under favorable conditions the entire root system of the plant is killed, and apparently the top dies as a result of this injury to the root. Under less favorable conditions only the upper portions of the root may be killed, and the plants may be reestablished by sprout development. The growth of seedlings, however, is under average conditions more serious than sprouting from the roots in the reestablishment of the dandelion plants. Plots sprayed on June 6, 1934, with straw-colored distillate sprays which killed both sod and dandelions, and reseeded with grass, gave an almost solid stand of dandelion seedlings which developed more rapidly than the seedling bluegrass. Adjoining plots which were sprayed

with water-white kerosene showed a 60 to 70 per cent. control of the old dandelion plants, and as far as could be observed no seedlings were able to maintain themselves in the only temporarily injured bluegrass sod. The ability of established sod to prevent the invasion of dandelion seedlings has been demonstrated by plots sprayed in May of 1933. Although completely surrounded by a very heavy stand of seeding dandelion plants, these plots at the present time show a dandelion infestation less than 2 per cent. of that present on the adjoining control plots. Fertilization, including the use of ammonium sulfate at the rate of one half pound per 100 square feet once or twice a year, is an important factor in maintaining a sod sufficiently close and heavy to prevent the invasion of dandelion seedlings.

We are continuing our work on the effect of biologic and weather factors and a more careful determination of the active constituents of the sprays. At present we are inclined to the view that saturated hydrocarbons of the medium boiling point series are the effective ingredients. More complete data will be published at a later date.

W. E. LOOMIS
N. L. NOECKER

DEPARTMENT OF BOTANY
IOWA STATE COLLEGE

AN APPARATUS FOR AUTOMATICALLY MAINTAINING REDUCED PRESSURE

A DESCRIPTION is given here of a simple device for maintaining reduced pressure automatically. The apparatus consists mostly of ordinary laboratory glassware, and can be built at very little expense.

A filter pump P (see sketch) is connected to a spring faucet F of the type which supplies water when the handle is depressed. The air tube of the filter pump is connected by means of glass tubing to a valve V, made of a 250 cc filter flask with a glass tube inserted through a rubber stopper and dipping into mercury in the bottom of the flask. The valve is connected, as is shown in the sketch, to a five-gallon bottle C_1, which is connected by means of glass, and rubber, tubing to a similar bottle C_2, several feet below. In each case glass tubing extends nearly to the bottom of the bottle.

Bottle C_2 is suspended from one end of a steel bar A, which is about 65 centimeters long, and which is in turn supported by a bolt through a hole about 16 centimeters from the point from which the bottle is suspended. A piece of steel wire is attached between a point on the bar above the center of the bottle and the end of the faucet handle. Near the other end of the bar are hung a three kilogram weight and a mercury leveling bulb B_1. A second mercury bulb B_2 is placed

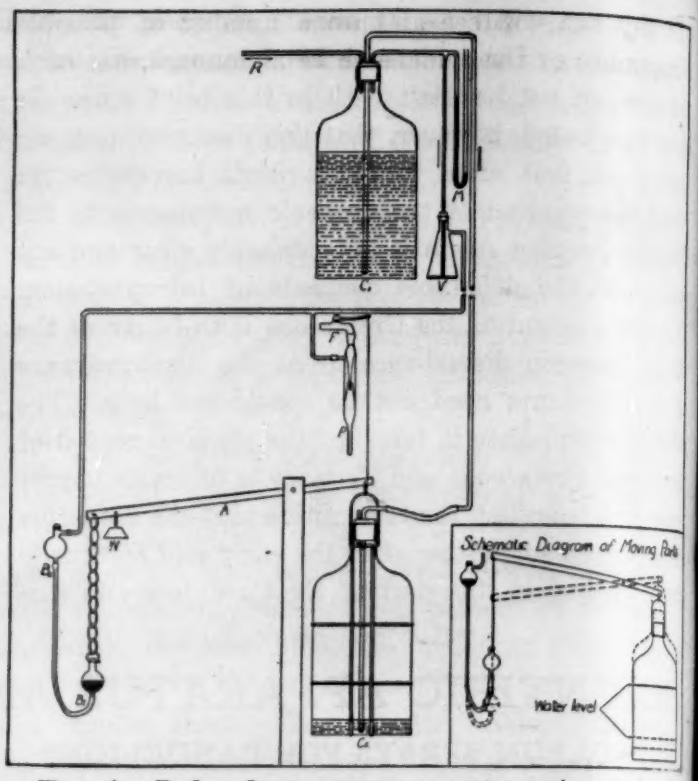


FIG. 1. Reduced pressure apparatus: A, arm, supported by bolt; B_1 and B_2, leveling bulbs; C_1 and C_2, five-gallon water bottles; F, water faucet; M, manometer; P, filter pump; R, laboratory reduced pressure line; V, air valve; W, weight.

in a stationary position and is connected so that mercury is free to flow from one bulb to the other, depending on differences in pressure. The air space of the bulb is connected to the air line leading to the pump by means of glass, and rubber, tubing.

A manometer, M, indicates the pressure in the reduced pressure line. Maximum variations of pressure were found to amount to seven cm of mercury while the apparatus was in use.

The functions of the various parts of the system may be seen by an examination of the sketch. The mercury and water assume the levels shown, when no air is being admitted, and after the system has come to rest. When the flow of water through the filter pump decreases to such an extent that the pump no longer draws air from C_1 the weight of the mercury, which then flows from B_2 to B_1, depresses the longer arm of bar A and allows the spring faucet to close completely.

The effective height of the water column between the two bottles is a function of the difference between the pressure in the reduced pressure line and atmospheric pressure. The difference between the elevations of the two bottles must be such as to give the desired reduction in pressure.

The original apparatus has been in constant service for two years without necessitating repairs or change in adjustment.

C. F. WINCHESTER

COLLEGE OF AGRICULTURE
DAVIS, CALIF.